Heating · Piping and Air Conditioning

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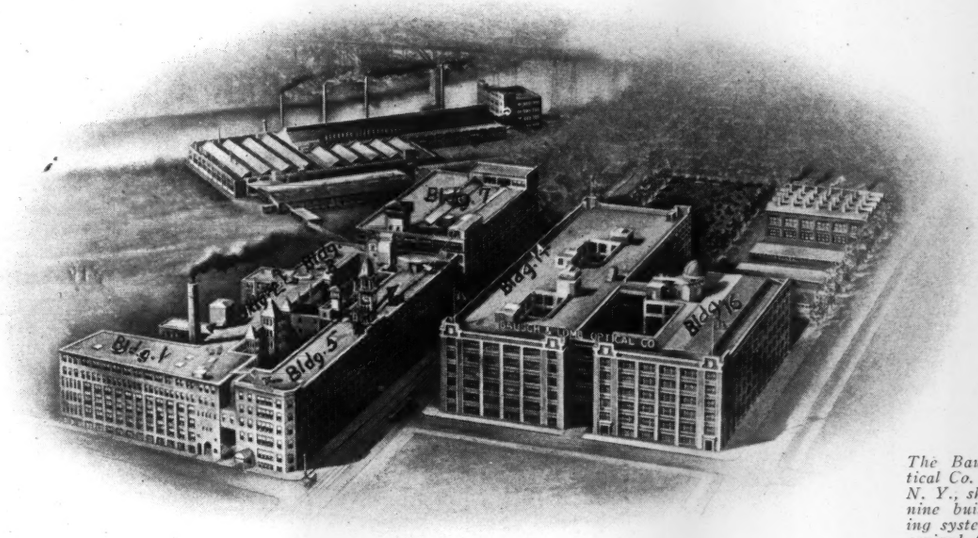


The Bausch & Lomb Optical Co. plant at Rochester, N. Y., showing seven of the nine buildings whose heating systems have been modernized (Buildings 4 and 8 not shown).

Bausch & Lomb Optical Company

MODERNIZES PLANT HEATING

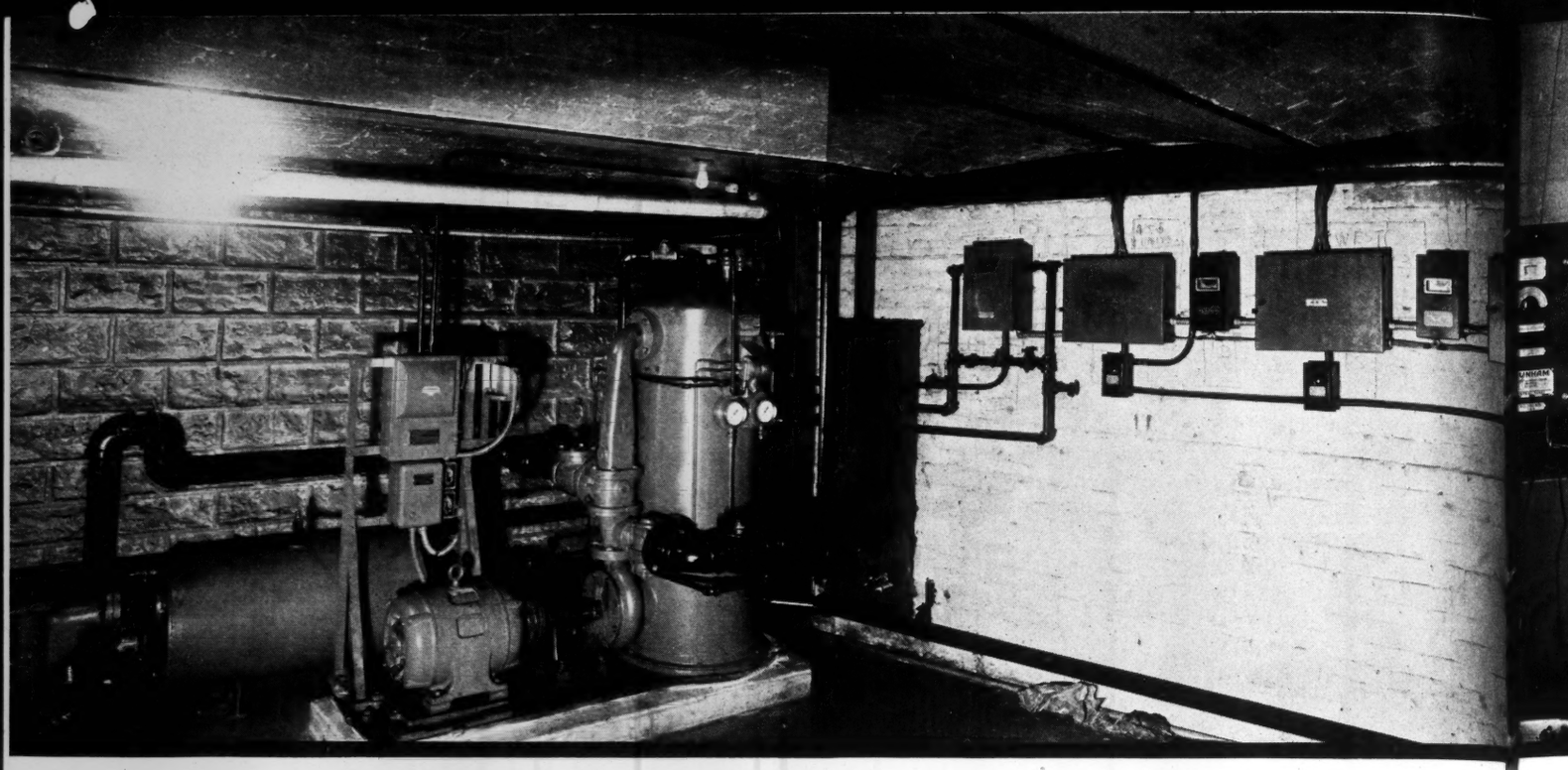
THE executive and general offices, laboratories, manufacturing and testing departments of the Bausch & Lomb Optical Company, Rochester, N. Y., occupy nine buildings which contain over a million square feet of floor space. Prior to 1931, over 80,000,000 lb of low pressure steam, purchased from the Rochester Gas & Electric Corporation, were consumed for heating purposes for an average heating season. During the 1933-34 season 47,094,600 lb of steam were used, a saving of 45 per cent effected by "modernization." How this was accomplished is the subject of this article.

In the fall of 1931, one building containing the lens polishing departments was changed from vacuum return line heating to differential vacuum heating with sub-atmospheric steam. Two seasons later, the remaining eight buildings in the group were similarly changed.

Prior to modernization, all Bausch & Lomb buildings were equipped with vacuum return line systems, operating with a steam pressure of 1 to 5 lb in the steam mains and a vacuum of 3 to 7 in. in the return mains. Direct cast iron radiators supplied approximately 65 per cent of the total heat requirements; the balance was supplied by six blast and air conditioning systems with heaters and fans located in the basements. The heated air was delivered by means of sheet metal ducts extending the length of the buildings, on the ceiling of each floor so heated. All direct radiators, blast and air conditioning heaters were equipped with thermostatic traps.

The First Change-over

The building containing the lens polishing departments was selected for the first change-over in 1931 because accurate steam consumption records had been obtained



Above—To the left is seen the new vacuum pump in Bldg. 5 and at the right is the differential vacuum controller, relays and time switches. Opposite—The operating engineer knows conditions throughout his heating systems at a glance. These control panels in the engineer's office in the basement of Building 3 are for Buildings 1, 2, 4, 7 and 8 and three zones in Bldg. 5. . . . One of the new unit heaters installed in the display room, Bldg. 5.

and were continually available, through the installation of a condensation meter and because the processes carried on in this building require the maintenance of at least 73 F during working hours and a minimum of 65 F at other times to prevent contraction moving the lenses on the polishing blocks.

This building is 119 ft wide, 390 ft long, six stories high, exposed on all four sides and containing 278,460 sq ft of floor space, 46,952 sq ft of glass and 400 cast iron radiators with 35,010 sq ft of surface.

Modernization involved the installation of new radiator and drip traps, packless radiator valves with regulating plates, and a differential vacuum pump in place of the traps, valves and vacuum pump previously in use. The heating system was divided into two zones, one serving the north and the other the south sections. Two inter-connected thermostats with related control equipment jointly govern the admission of steam to the heating mains, through a motorized control valve. Each zone is controlled in this manner. The returns from both zones are connected to one vacuum pump.

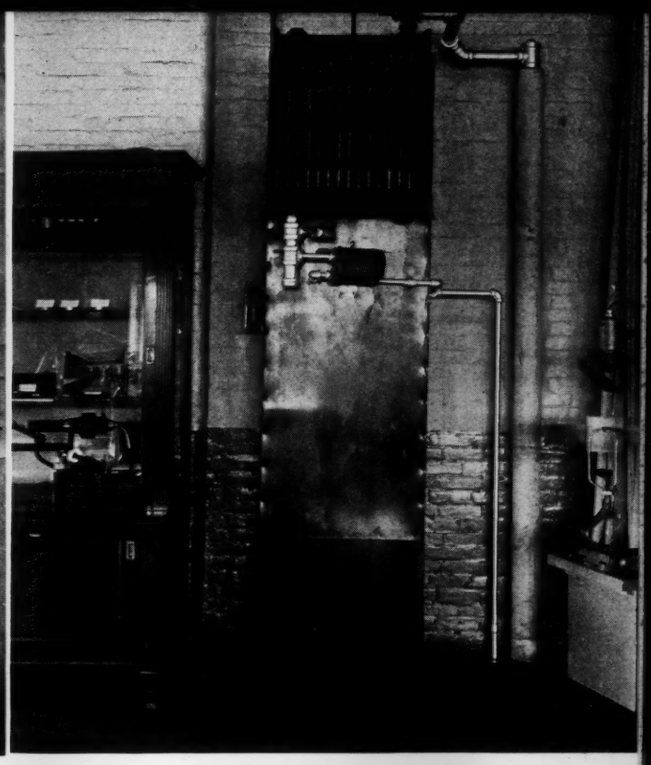
Under the previous operation, steam had been consumed at the rate of 3,200 lb per degree day, or at the rate of 91.4 lb per 1,000 sq ft of radiation per degree day (degree days based on 65 F outside temperature). From January 1, 1932, to May 31, 1933, there were 9,847 degree days, a total steam consumption of 21,068,700 lb or a consumption rate of 2,139.6 lb of steam per degree day. The new heating system thus effected a saving of 33.2 per cent of the steam required.

Completing the Change-over Program

The improvement in temperature regulation and the decrease in steam consumption recorded in the lens polishing building led to the decision to change over the other eight buildings to sub-atmospheric steam heating in the summer of 1933. In seven buildings, all existing piping, blast and air conditioning heaters, fans, duct work, traps, valves and vacuum pumps were dismantled and removed, only the old radiation being re-used. The eighth building, being heated solely by a vacuum return line system, required less extensive changes.

Zoning—In the new installation, Building No. 1 having a south, west and north exposure, is equipped with its own control equipment and vacuum pump; Buildings Nos. 2, 3 and 4 having a primary western exposure and practically uniform temperature requirements, are grouped into one zone having its individual control equipment and vacuum pump; Building No. 5, comprising the executive and general offices, as well as the government testing department, is divided into three zones: east office zone, west office zone and governmental zone on the two upper floors. Returns from all three zones in this building are connected to one vacuum pump. Buildings Nos. 7 and 8, containing the lens grinding and the polishing departments and the chemical laboratories with exposure on all four sides, have one control zone and one vacuum pump; Building No. 14, in which the new system was installed in 1931, has two zones and one vacuum pump. Building No. 16, with exposure on four sides, has also one zone and one vacuum pump.

The entire change-over involved the furnishing and installation of 230 new cast iron radiators containing 13,862 sq ft of surface, the reconnecting of 722 old radiators containing 61,051 sq ft of surface and the installation of 116 unit heaters with two-speed motors



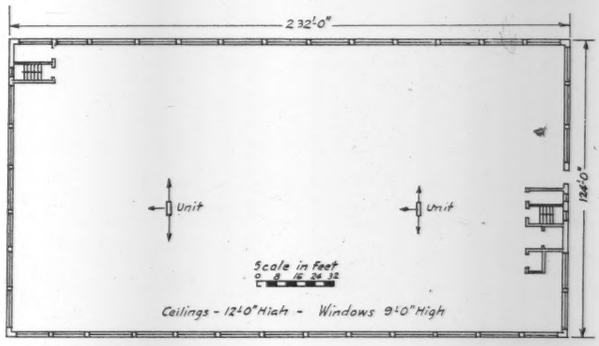
containing 73,087 sq ft of equivalent direct radiation when operating at high speed. Other new equipment included traps, radiator valves, regulating plates, differential vacuum pumps, unit heater thermostatic control and nine sets of the control appliances which govern the pressure, temperature and volume of sub-atmospheric steam circulation.

Unit Heater Control and Operation—Unit heaters are installed in practically all manufacturing spaces as well as in the tabulating, purchasing and payroll departments. The unit heaters are controlled to give a room temperature of 68 F. Each unit heater is equipped with a limit switch, located between the radiator of the unit and its trap, which prevents fan operation unless the steam temperature at the limit switch is at least 135 F, which obtains at approximately 24½ in. vacuum. In addition to the individual thermostatic control of the unit heaters, the temperature, pressure and volume of the steam circulated in each zone is also automatically controlled by the normal operation of the sub-atmospheric system. With the total heat output of each zone thus governed in accordance with the heat losses, the thermostatic controls upon individual unit heaters function only to equalize slight irregularities in distribution of the heat. The combination of thermostatic control of the unit heater motor and thermostatic control of the temperature of the steam circulated not only provides maximum building comfort but also effects great fuel savings.

Centralized Control—At all times during the normal operation of the heating system, the operating engineer is conversant with conditions throughout the buildings, as a glance at the control panels tells the approximate building temperatures being maintained. In case of emergency any zone of the entire system can readily be changed from automatic to manual operation and the amount of steam supplied through the control valve accurately controlled.

Economies of Modernization

Under former operation, steam for all buildings had been consumed at the rate of 12,044 lb per degree day, or for a calculated heat loss of 122,500 sq ft of equivalent direct radiation at a rate of 98.3 lb. per 1,000 sq ft of required radiation per degree day. From September 1, 1933, to May 31, 1934, there were 7,109 degree days and a total steam consumption of 47,094,600 lb, giving



Typical floor plan for Building 7, showing location of the two unit heaters. This modernization project involved the installation of 116 two-speed unit heaters

a consumption rate of 6,625 lb of steam per degree day or 54.1 lb per 1,000 sq ft of radiation per degree day. *The steam saving for the* 1933-34 *heating season was* 38,526,200 *lb.*

The above operating data for the sub-atmospheric steam system date from September 1, 1933, although the control equipment in all buildings was not placed in final operation until after January 1, 1934, so that the percentage of saving for succeeding years may well exceed those effected during the past heating season. In addi-

tion to this saving in steam, the modernized installation, by eliminating the large electric motors required for the blast and air conditioning system, is resulting in a power saving of over $3,600 per year.

Under present operation, steam circulates continuously at varying pressures and temperatures and in varying volumes in accordance with the demand for heat.

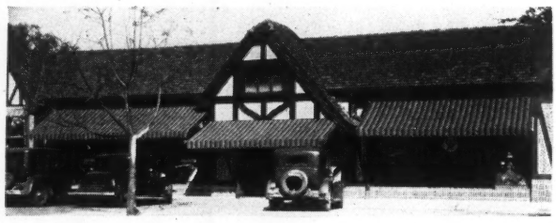
Despite the extensive changes in equipment, the entire cost of the change-over will be paid from steam savings in less than three and one-half years. After this period, the owners not only reduce their operating costs for heating by 45 per cent but also receive the inestimable benefits resulting from improved product quality and increased employee efficiency in manufacturing products that demand the ultimate in precision and accuracy.

OPERATING RECORDS SHOW STEAM SAVINGS

	Before Modernization *Average Rochester Heating Season*		After Modernization *Sept. 1, 1933 to May 31, 1934*		
	Degree Days*	Steam Consumption, Lb	Degree Days*	Steam Consumption, Lb	Lb Steam per Degree Day
Sept.-Oct.	500	5,350,000	558	2,423,700	4343
November	789	10,248,700	909	6,383,800	7023
December	1105	13,402,600	1165	8,291,400	7117
January	1251	15,888,200	1161	8,434,700	7265
February	1129	13,485,100	1527	10,765,600	7338
March	1029	13,715,000	1037	7,221,900	6964
April	604	6,073,200	607	3,128,300	5154
May	245	1,954,200	205	445,200	2172
Total	6652	80,117,000	7109	47,094,600	Ave. 6625

*Degree days based on 65 F inside temperature.

GROCERY STORE *ups sales and profits by* AIR CONDITIONING



ANY skepticism in the beginning as to the value of air conditioning on the part of executives of Jitney-Jungle, Inc., Jackson, Miss., has now been dispelled. This concern operates more than 100 chain grocery stores in the south and southwest and about one year ago in a remodeling program for its super-store in Jackson installed an air conditioning system at a cost of about $4,000.

Since the remodeling, business has shown by actual figures a 39 per cent increase. Average monthly sales for 1934 up to September 1 jumped up $4,206.50 over the same period last year. To be more exact the average monthly profit through August of this year from this one store was $391.39 more than the average monthly profit before remodeling. This, of course, makes allowance for the cost of operating and maintaining the air conditioning. So it might be said that the proof of the pudding (air conditioning) is the profit derived therefrom.

Cost of operating the cooling system averages $150 a month; this includes $110 for power, refrigerant, etc., and $40 a month to cover interest on the investment, insurance, depreciation and other fixed charges. No operating trouble has been experienced.

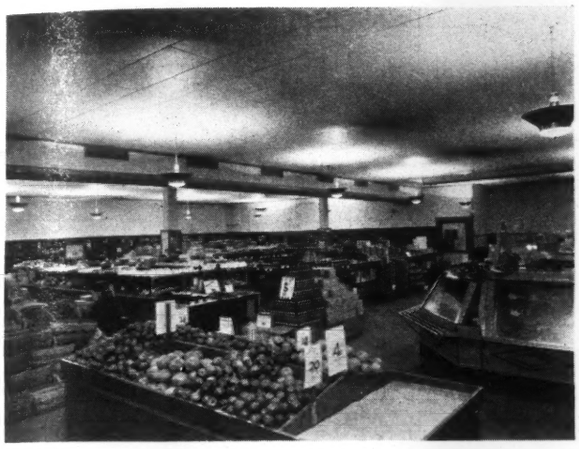
Proves Value of Air Conditioning

The Jackson store was chosen more or less as a proving ground for air conditioning, owners of the chain admitting that at first they were not overly impressed by the claims made for it as a business builder. They figured, however, that the novelty of air conditioning and the advertising it would give them would — if nothing else — largely compensate them for the cost of the installation. At that time there were no other stores of any kind in Jackson with air conditioning and very few grocery stores in the entire south with this convenience. Operators of the chain are so well pleased with the results obtained that they are now planning to make installations in other stores.

The refrigeration equipment consists of three compressors placed in series. Cooling and dehumidifying is accomplished by circulating the air by centrifugal fans over direct expansion coils, through which the refrigerant (F-12) is circulated. The system is guaranteed to cool the conditioned spaces to 78 F when the outside dry bulb temperature does not exceed 95 F, nor the wet bulb 78 F, or maintain at least a 17 F drop in the dry bulb temperature when outside dry bulb temperature exceeds 95 F. Relative humidity of about 50 per cent is maintained.

The motors have a combined horsepower of 12½ hp. Each of the three refrigerating units has a 3 hp motor and the air conditioning unit a 2 hp motor. A 1½ hp motor is used for the cooling tower mounted on the roof.

The galvanized steel supply ducts are run exposed along the ceiling, but have the appearance of large beams which blend with the interior decorations. The conditioned air is discharged through slotted type outlets, equally spaced in the sides of the ducts. Sufficient air circulation is provided to take care of as many as 100 persons in the store at one time. All windows and doors except the public entrance are kept closed.



Air supply ducts run exposed along the ceiling. The grilles through which the conditioned air is forced are located in the sides of the ducts near the ceiling line

Advantages of Air Conditioning a Grocery

Immediately after the installation the store became the talk of the town, according to W. H. Holman, president of the Jackson Jitney Jungle Stores, Inc. While the novelty of air conditioning cannot last indefinitely it does give a distinct advantage to the first store in a city to make the installation, he pointed out.

"Customers immediately responded to the increased comfort of the conditioned store," said Mr. Holman. "We particularly noted a sales increase during the height of the summer season, when the tendency too often is to blame bad business on the weather and dismiss it with a sigh. Air conditioning is especially desirable in the south as the hot seasons extend over six or seven months of the year.

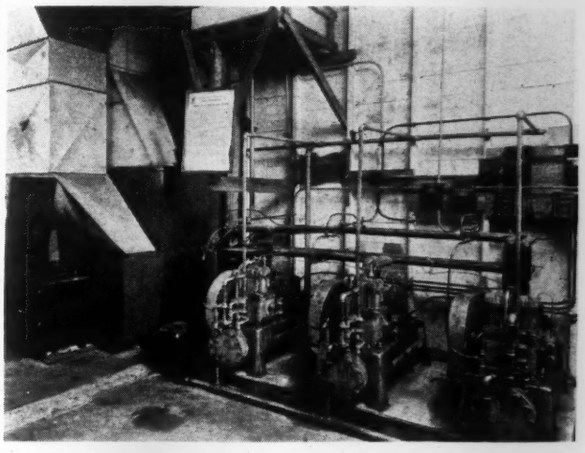
"Store employees also buoyed up under the improved working conditions. There is no longer any mopping of brows or perspiring cashiers and stockmen. An observant customer cannot help but notice a more attentive attitude on the part of the store personnel, due to a more invigorating atmosphere. This may have accounted for some of those extra sales which chain stores expect of their employees.

"One of the worries of chain stores is food spoilage. We are glad to report that fruits and vegetables remain in a much better condition since we installed the cooling system. Some of our increased profits may be ascribed to this fact.

"In short we have found that air conditioning is one feature that makes one chain store stand out above another chain store."

W. B. McCarthy is president of the entire Jitney-Jungle organization which is now engaged in an expansion program, opening several new stores in eleven southern states.

Refrigeration equipment consists of three compressors placed in series. Cost of operating the cooling system averages $150 per month



Customers respond to increased comfort . . . Store employees buoy up, are more attentive, make more sales . . . Fruits and vegetables remain in better condition . . . Air Conditioning makes one chain store stand out above another

Alkaline Wash Water for Purification of Air

Many instances of severe corrosion of metal parts of air conditioning equipment have come to the attention of the National Bureau of Standards subsequent to publication of its report (*Miscellaneous Publication No.* 142) on removal of sulphur dioxide from library air. In this report, it was stated that washing the air with alkaline wash water was found necessary for complete removal of the acid-forming sulphur dioxide, and that such treatment protected not only the books and other stored material in libraries but also the air conditioning equipment. In some instances extensive and expensive replacement of the metal parts of air conditioning systems has been found necessary within a few months of operation, when alkaline treatment of the wash water had not been practiced. Corrosion is not always caused by sulphur dioxide; other impurities or even normal constituents of both air and water, such as carbon dioxide, are corrosive. Maintenance of alkalinity of the wash water at 8 pH or somewhat above this and the use of chemicals which form protective coatings on metals, are said to be effective protection against corrosion providing the kind and amount of chemicals used are adjusted to the components of the air being treated and those of the water being used for the purpose. Removal of certain odors is also said to have been effected by alkaline treatment. As the proper choice and adjustment of the chemicals require highly specialized knowledge, the services of engineers particularly experienced in such work should be obtained in initiating the treatment.—*News Bulletin, Paper Section, National Bureau of Standards.*

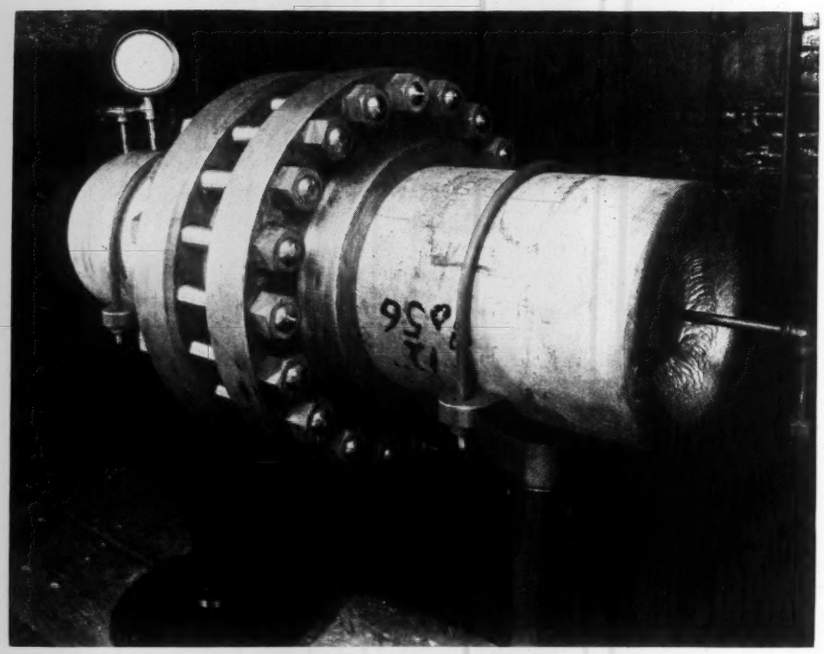


Fig. 1 (left) and Fig. 2 (right)—To find out if, over a long period of years, the flanges and bolts might creep enough to reduce considerably face-to-face pressure of the flanges, a test was run in which a section of pipe with a flange in its center was subjected to hydraulic pressure and the bolts gradually slackened uniformly, simulating the effect of creep. These are general views of this flange in position for testing

Piping at High Temperatures

WE have all become so accustomed to the hardness and strength of steel that it is something of a shock to have to deal with it under conditions that render it relatively weak and soft. Of course, the blacksmith shapes his metal at a red heat, where it follows the hammer readily enough, but heretofore we have not had to deal with such temperatures in everyday usage. The advantages of higher temperature steam in power and industry now make it imperative to leave the accepted zone of "high temperature" service and enter the relatively little known field of temperatures from 750 F upward.

Steel begins to glow in the dark as it approaches 900 F and as the temperature is further increased it becomes markedly plastic. When a specimen is tested in a laboratory with sufficiently delicate instruments, it is found that this plasticity really begins at much lower temperatures, somewhere around 600 F. In this condition however the plasticity is negligible and it is not until plain steel is heated to the neighborhood of 750 F to 800 F that the change in physical properties seriously affects the service rendered by the material.

As the need for higher temperature piping and apparatus became more pressing the properties of metals at these temperatures received more attention. Now a great deal of thought and research work are being expended in the effort to understand the peculiar effects that appear, and to develop materials suitable for the new conditions.

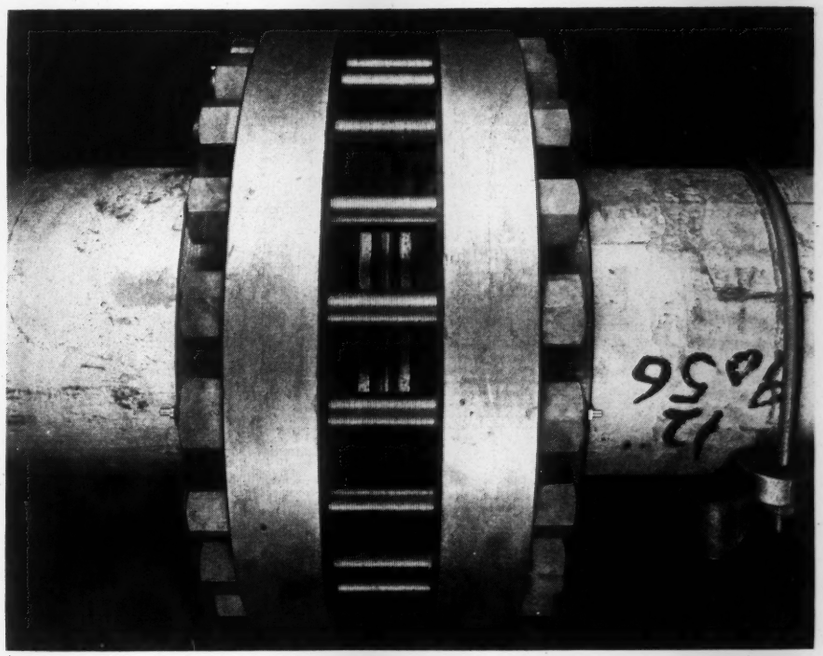
It has been found that when a piece of steel is heated to, say, 1,000 F and is placed under load it gradually changes its shape. For instance, if a weight is suspended by a heated bar, it is found that the bar gets longer as time goes on and may eventually stretch to a point where it can no longer support the weight and consequently breaks. This action is usually very slow. It may require days, or even months or years, to reach the breaking point, but the progress can be charted from hour to hour by laboratory instruments. A graph of such a record gives a picture of what takes place. At first the bar stretches rapidly, then more slowly, after which it comes to a very interesting part of its history. Under certain conditions the rate of stretching begins to increase again and sooner or later the bar breaks. Under other conditions the rate of stretching continues to grow less and eventually becomes negligible or stretching ceases altogether. If this is the case the bar does not break and the load is supported indefinitely.

The conditions that determine which of these characteristics will develop are the temperature of the bar, the amount of load for a given size of bar (that is the stress in the bar) and the composition and quality of the metal. For a given metal there seem to be fairly well defined values of loading and temperature that limit the stretching to the safe type that gradually diminishes and does not produce breakage. Within these limits the conditions may be changed at will with safety. The general rule holds that the lower the loading for a given temperature (or *vice versa*), the less will be the tendency to stretch and the less will be the total stretching during the useful life of the material.

Engineering usage has developed certain terms and measurements for these conditions. The stretching (or bending, etc., as the case may be) is termed "creep" and is usually measured in per cent of the original length.

*Stone & Webster Engineering Corporation, Boston, Mass.

By E. W. Norris*



Some of the considerations involved in the selection of materials and design of piping for higher temperatures, the 650 lb.—850 F piping for Buzzard Point being used as an example

The effect of time is allowed for by specifying a given number of hours during which a given amount of stretching may take place. This time varies but it is common practice to specify either 10,000 hours or 100,000 hours. The former is probably the more usual at present. For example, a steel may be specified as having not more than 1/10 per cent total creep in 10,000 hours at 900 F. This means that under a specified stress the steel will not stretch more than 1/10 per cent of its original length during the first 10,000 hours of service at 900 F.

Piping for 650 Lb and 850 F

An example of the application of this new development in engineering practice is the design for the steam piping in the Buzzard Point Plant of the Potomac Electric Power Company, Washington, D. C. In this plant, higher steam pressures and higher temperatures have been used for the improvement of power generating economy. The design selected calls for a nominal steam pressure of 650 lb per sq in. at a temperature of 850 F. These conditions bring the piping within the zone of creep conditions and careful studies of these phenomena were made on which to base the design of piping and pipe joints.

Research carried on abroad has shown that pipes subjected to creep conditions stretch so as to increase in diameter but owing to the peculiar relation of the stresses involved the length does not change. This is a fortunate circumstance as the length is so much the greater dimension that a change in it would be serious. A change in diameter is relatively less important and can be allowed to take place to such an extent as will not interfere with the service of pipe and associated parts, say a total of one per cent during the life of the part. For the Buzzard Point Plant the creep limit was specified as not over 1/10 per cent in 10,000 hours, which a careful study of the action of the steel indicates to be considerably within the limitation mentioned. With this creep specification, a reference to test data indicates a safe continuous loading at 850 F to be 6,000 lb per sq in. or 5,000 lb per sq in. at 875 F allowing 25 degrees for a factor of safety. The thickness of piping material was then calculated on this basis with such additional allowances as required for variation in size and quality of commercial pping. It was found that the proper thicknesses could be obtained in commercial pipe sizes, thus making it unnecessary to purchase special material.

Design of Connections

The design of connections for pipe and fittings required more elaborate treatment. Calculations were made of the stresses in standard type flanged joints of the 600 lb and 900 lb series. The conditions of operation assumed were made more severe than those expected in order to provide against possible variations in later use. It was found that by selecting 900 lb series flanges the stresses would fall within values attainable with commercial materials of the better grade—that is, in the neighborhood of 10,000 lb per sq in. The specificatior for flanges and bolts required a total creep of less than 1/10 per cent in 10,000 hours under a stress of 15,000 lb per sq in. at 900 F. No difficulty was experienced in obtaining materials under these specifications. The flanges were made of an alloy steel containing approxi-

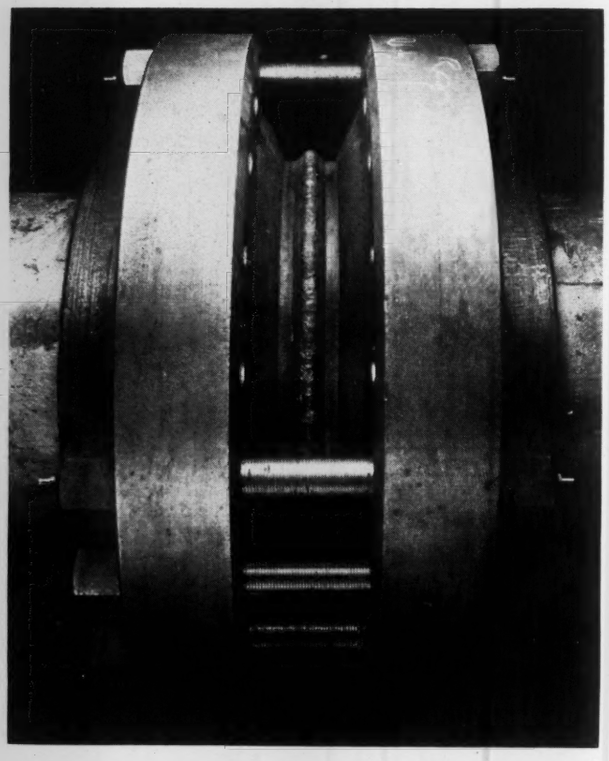


Fig. 3—Following the first tests, the gasket was removed and the flanges seal-welded as shown here. The test then proceeded as before

mately 1.1 per cent tungsten and 5 per cent chromium. The bolts were also of alloy steel but contained approximately 5 per cent molybdenum in place of the tungsten to give the desired resistance to high temperatures.

Face-to-Face Flange Pressure

Over a long period of years it is possible that the flanges and bolts may creep enough to reduce considerably the face-to-face pressure of the flanges. This raised the question of the minimum pressure essential to steam tightness. To throw light on this requirement, a test was run in which a section of pipe with a flange in its center was subjected to hydraulic pressure and the bolts gradually slackened uniformly to release the face-to-face pressure, thus simulating the effect of creep over a long period. Figs. 1 and 2 show general views of this flange in position for testing. It will be noticed that the bolts have been ground for micrometer readings of length and four bolts have pins in the ends as an additional aid to accuracy. These latter bolts were calibrated in a tension testing machine before the tests.

The first test was made on the flange with a compressed asbestos gasket. The initial stress in the bolts was 37,000 lb per sq in. which corresponded to a face-to-face pressure on the gasket of 8,700 lb per sq in. The tightness of the joint was tested under hydraulic pressure of 900 lb per sq in. The hydraulic pressure was then relieved, the bolt tension was slightly reduced and the hydraulic pressure was reapplied. These steps were continued at successively lower bolt tensions. The first definite signs of leakage occurred when the bolt stress had been reduced to approximately 8,000 lb per sq in., so that the gasket pressure was only slightly in excess of the hydraulic pressure in the pipe.

Flanges Seal-Welded

Following this test the gasket was removed and the flanges were seal-welded as shown in Fig. 3. The bolts were then tightened to their original tension and the test proceeded as before, reducing bolt tension and testing under pressure at each step. It was found that the flange remained tight when no face-to-face pressure existed. Then, as bolt tension was further reduced, the sealing bead of welding was found to support a considerable portion of the hydrostatic pressure. After the bolts had been entirely slacked off, it required a hydraulic pressure (resisted solely by the seal weld) of 600 lb per sq in. before a leak appeared and approximately 1,000 lb before it became appreciable.

In view of the ability of the seal-welded joint to maintain tightness without face-to-face flange pressure it was considered preferable and was adopted for the high temperature service.

Results of the Tests

The results of these tests were considered to indicate that joint tightness can be maintained with much lower bolt tensions than had hitherto been thought essential. Thus the effect of creep may safely be allowed to proceed provided that the basic design has established proper values over the life of the equipment. For this reason a certain amount of stretching or creep may be anticipated and need not cause anxiety unless the design values are exceeded.

A further result of experience with these tests is the facility with which bolts can be set to a desired tension in commercial piping work. This avoids damage to bolts by overtightening and general uncertainty as to the results obtained.

In erecting the Buzzard Point Plant piping all joints were identified and the bolts of each joint numbered. A record was made of the original length and the length after tightening for each bolt. It was arranged that all bolts should be tightened to a predetermined stress by reference to a table of bolt elongations prepared from the calibration tests.

It is interesting to note that after nearly a year of operation, when two flanges were dismantled and checked for creep, it was found that this was proceeding approximately as expected, and specified.

The work leading up to the design of this piping was undertaken early in 1933, when much of it was original. Since that time the codifying committees of engineering societies and associations of manufacturers have covered much of this ground and have incorporated the results in their preliminary drafts of codes.

NO. 1 OF A SERIES ON BUILDING CONSTRUCTION

Design and Construction of Modern Buildings *must*

Allow for Air Conditioning

Much can be done to permit economical and effective application of air conditioning by providing certain features in building construction, according to S. A. McGuire.*

THE necessity of providing at least a number of features in building construction in anticipating the widespread application of air conditioning is becoming more obvious each year. The expectation, and indeed the demand, for air conditioning, is becoming stronger and more pronounced; therefore it seems fair to assume that, within a very few years, practically all business buildings of the office class, also bank and monumental structures, together with hotels, clubs and buildings of other types may have as part of their equipment air conditioning systems of either the central plant or the unit type. The rapid development of and requirement for "comfort zone" air has been such as make necessary rather important, difficult and expensive changes in buildings which have been constructed without thought of air conditioning and which otherwise may be considered quite up-to-date.

As an example of this one particularly large building of the very highest type office class was constructed a very few years ago and was equipped, presumably, with the last word in mechanical devices. The ventilating portion of the plant comprised a vast amount of duct work, a large number of blowers—something like 50 or more—air filters, the usual heaters and reheaters and thermostatic control, with *no* provision (to my knowledge) for either cooling, dehumidifying or humidifying. The initial expense of installing the requisite equipment for supplying completely conditioned air would undoubtedly have been justified. The cost of such changes as would be required to provide for the various apparatus at the present time would perhaps be prohibitive. Yet the ever increasing demand for air conditioning may compel the changes to be made.

In other instances, however, various types of ventilating systems have been installed on the basis of cooling in summer without refrigeration and humidifying in winter. Such a plant under intelligent operation would accomplish the purpose for which it is designed; but with some structural over-sight or weakness, the plant may be ineffective—at least very largely so.

Apropos of such a condition, a very beautiful building in New York, not considered in the *large* class, was built a few years ago and well equipped structurally and mechanically. The air supply system was designed to give a cooling effect of 8 to 10 F in summer with no refrigeration and to humidify in winter. The plant was, upon completion, operated under a test and found to comply with the requirements. Windows, however, were provided of the *single type* only and so arranged as to be *readily opened,* which fact invited trouble with the conditioning system. The real hot days came along —two years ago—and the usual thing was done—all windows were opened—notwithstanding the fact that the plant was operating under peak conditions—with outside dry bulb of 95 F. This, of course, resulted in admission of street noises and heat, dust and dirt into the library and reading rooms of the building, which, obviously, should be provided with every device possible conducive to quiet and comfort.

This wasteful and futile method and practice of "ven-

*The author was for fifteen years associated with Cass Gilbert, Inc., Architect, during thirteen of which he held the office of Chief Mechanical Engineer. Among the buildings equipped under his supervision are the Federal Reserve Bank, Minneapolis; U. S. Chamber of Commerce, Washington, D. C.; Home Insurance Company, New York City; American Academy of Arts and Letters, New York City; West Virginia Capitol Group, Charleston; Prudential Insurance Co., Newark, N. J.; New York Life Insurance Co., New York City; U. S. Courthouse Building, New York City; U. S. Supreme Court Building, Washington, D. C., and many others.—The Editors.

U. S. Supreme Court Building, Washington, D. C.

tilation" was finally explained with proper instructions to accomplish satisfactory results—but not until after the occupants had suffered from excessive outside heat, dust and street noises and the owner compelled to pay bills for wasted electrical energy. Had the windows been double or even so arranged as to be opened for cleaning only, the condition described would not have happened, the occupants would have enjoyed the quiet, and would have been provided with fresh clean air taken from the extreme top of the building, filtered, washed and cooled.

Another example, somewhat different from those described, is that of an individual bank building not far from New York, built approximately eighteen years ago and in which were installed very large windows of the double-plate glass type made stationary—for the purpose of fuel saving and perhaps for quieting effect. The ventilating equipment consisted of the usual reheating and preheating sections, air washer, blowers, etc. The plant had been out of commission for some time; but with comparatively small expense it was reconditioned to a permissible extent by installing filters, humidity control, and by revamping the washer. The results are highly satisfactory, both in cooling and humidification; and the building may be considered up-to-date as far as equipment is concerned,—due in part to the type of windows used together with well-constructed and insulated walls, etc.

The Modern Building a "Conditioned Air Factory"

Inasmuch as air conditioning, as generally understood, may be defined as a method or process by which a proper, satisfactory and comfortable condition of the air may be produced, it is desirable therefore to "protect" or isolate the manufactured product from outside influences as much as possible, using such devices as properly designed and arranged windows, suitable shading for same, and well constructed walls with a proportionate amount of effective insulating material.

The modern building of almost any type which is air conditioned may be considered more or less a factory in which entering air may be classed as raw material from which the "finished" product is delivered through the medium of various apparatuses, machinery, etc.—sufficient installation and operating space for which should obviously be provided.

The element of quiet is closely associated with a good air conditioning system; as, with the advisability of windows being closed during the operation of the plant, street noises with their unpleasant features are practically entirely eliminated.

Much can be done by the architect and engineer to enable the effective and economical application of air conditioning to a building. With air conditioning and its advantages accepted as they now are, it is important, if the owner's best interests are to be served, that proper consideration be given to the design of the building itself so that the air conditioning engineer can design and install a system for efficient and economical operation, reasonable first cost, and satisfactory service.

U. S. Courthouse, New York City

Coal Mine Installs New Fan—Saves $552 Each Month

A saving of $552 every month is well worth making in any mine, and that is what the Old Ben Coal Corporation secured at West Frankfort, Ill., last year by changing fans. They report the following data:

For the old fan 16 ft x 5 ft—

Fan speed, 123 rpm
Volume of air delivered, 113,856 cfm
Static pressure, 3.56 in. of water
Kw input to motor, 118.5 kw
Overall unit of efficiency, 40.3 per cent

With the new unit the tests showed on an 8 ft x 4½ ft fan—

Fan speed, 318 rpm
Air volume, 117,300 cfm
Static pressure, 3.60 in. of water
Total pressure, 3.665 in. of water
Kw motor input, 64.8 kw
Overall unit of efficiency, 78.1 per cent

The test was repeated three times, using sectioned airway readings. Analysis of these tests shows an efficiency of 84 per cent for the fan and a unit efficiency covering V-belt drive losses and motor losses of approximately 79 per cent.

The fan manufacturer states that when their fan is accurately tested it shows a maximum mechanical efficiency of 79 per cent and that their guarantee is 75 per cent. The fan company states that they believe that about 15 per cent of the efficiency shown by this installation is due to the roller bearings used.—H. K. Robb.*

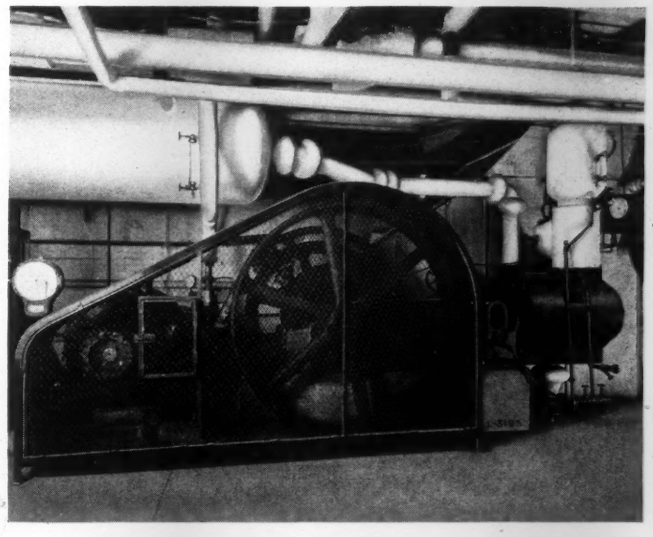
*The Timken Roller Bearing Company.

Steam Booster Compressors

Simplify Piping

. . . . . when a plant or building needs some steam at a higher pressure a booster compressor may be the solution

By C. G. Kohl*



Electric driven steam booster in an office building which runs eight hours daily boosting pressure from 35 to 60 lb

OFTEN a plant engineer is confronted with the problem of supplying steam and piping steam for a particular manufacturing process at a pressure considerably higher than is obtainable from the existing boiler plant. Again, there might be a demand for high pressure steam to be piped to some outlying building where there is a supply of steam only at the heating system pressure, even though the main plant may have high pressure steam available. The problem, then, is to arrange to furnish a constant supply of steam at the required pressure with a minimum amount of expense. In the first instance, at first appearances it would seem that a new high pressure boiler must be installed to deliver steam at the required pressure. In the second plant, it would appear that a new high pressure steam line must be installed to the outlying building.

In both cases, providing the demand for steam at the higher pressure is within reasonable capacities (that is, not exceeding 75 boiler horse power such as is often encountered), it will often be found economical to utilize either a steam- or motor-driven steam booster compressor to supply the necessary higher pressure steam. These booster compressors are designed to receive steam from the existing system at the pressure carried in the lines and compress it to the required pressure, just as air is compressed in a standard air compressor.

It will be seen that such an installation would save the cost of a complete new boiler and attending accessories in the first plant and eliminate laying a long and expensive high pressure steam line in the second case, the cost of which would also be increased by insulation to protect it from climatic changes.

A steam booster compressor can frequently be installed for a fraction of the expense that would be necessary to make either of the changes above mentioned. Further, due to the reliability of such an installation, it can be operated with practically no attendance—except an occasional inspection of oil levels.

*Commercial Engineering Division, Worthington Pump and Machinery Corporation.

Another practical application of this equipment will be found in a large hotel or office building purchasing steam at a low pressure for heating purposes from a central heating system. Such circumstances generally make an ideal spot for the installation of an economical steam booster compressor because: (1) There is always a chief engineer in the building who could easily take care of a small additional compressor installation with practically no increase in his routine duties. (2) The building is generally so built that a high pressure boiler could not be installed without excessive expenditure. (3) No coal or ash handling problem is encountered. (4) Control is entirely automatic supplying exactly the proper pressure and correct amounts of steam to meet the varying demands. (5) Maintenance is negligible since compressor repairs are required but infrequently.

Since steam reacts to increases or decreases in pressure, the same as air or other gases, this characteristic is frequently brought into use to obtain definite temperatures within close limitations for testing or regulation purposes. Suitable controls can be furnished with these booster compressors to regulate either the pressure or the temperature of the output steam within very close limits. Numerous installations of these units are made in chemical or special industrial plants (such as the manufacture of moulded electrical insulation) where it is necessary that a definite temperature be continuously maintained with practically no variation.

The construction of a steam booster compressor should be carefully engineered in order to obtain a unit to give the most satisfactory performance, and constructional details should be given careful consideration when this type of equipment is selected. The cylinder should be efficiently lagged, reducing the heat loss to a minimum.

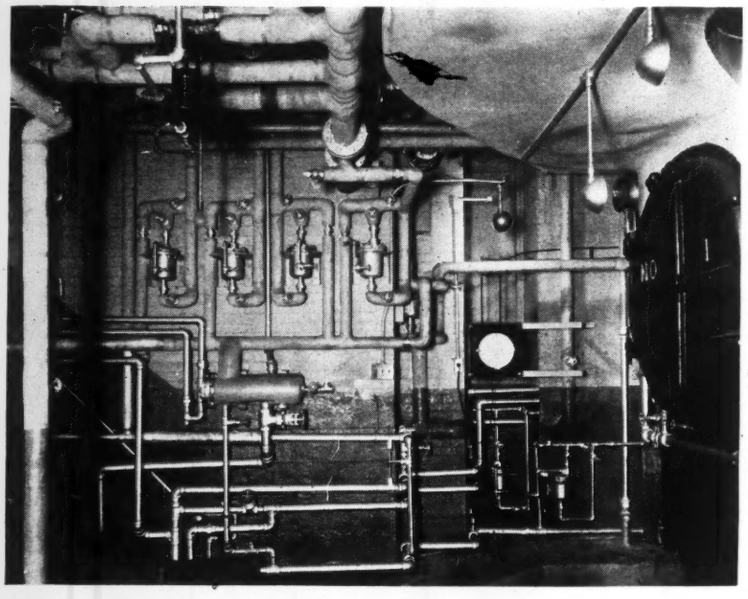
Steam boosters may be driven through a V-belt drive from a motor or if a complete steam operated unit is desired, low pressure steam may be used for driving by means of a conventional steam cylinder. Thus the most economical power available may be used.

Despite the addition of a new building, an increase in the number of patients cared for, and a 23 per cent increase in degree days the new boilers used 15,711 less gallons of fuel oil for the first six months of this year than did the old boilers for the corresponding period the previous year

By C. W. Kimball*

The modernization work included the installation of economizing heaters to condense the vapor from the high pressure traps, as shown here. Other work included overhauling and renewing all traps to put them in good working order. Meters were installed in the steam lines and in oil lines to check plant operation

Heating Plant Check-Up PAYS!



Consulting Engineer Investigates, Hospital Invests, Heating is Improved

ALTHOUGH much has been done to improve operating efficiencies and economies in the mechanical plants of schools, hospitals and other institutions, there are still many such plants in which real and worth-while savings could be made at reasonable first cost. A good illustration of what is possible—by proper study and planning—along this line is the case of one of the best known hospitals of Greater Boston. The age, condition and capacity of the boiler plant, coupled with the fact that more capacity was needed to supply the demands of a new seven story building being erected, made changes absolutely necessary.

This boiler plant consisted of two—110 hp horizontal return tubular boilers twenty-six years old, fired with steam-atomizing oil burners using No. 6 oil. The boilers operated at 90 lb pressure and supplied all steam required for hospital heating, hot water, sterilizing, cooking and laundry work. According to records kept at the hospital, there was a total of 35,000 sq ft of equivalent direct radiation served by the plant. The new building was to add 10 000 sq ft to the load or approximately 30 per cent increased demand.

As the two boilers were in use both summer and winter there was very little chance for repairs or renewals and as the boilers operated at approximately 200 per cent rating quite often during the winter, no spare capacity to take this added load was available. The boilers were located partly under a service driveway entirely below grade and partly under the basement of the building; space available for expansion was extremely limited.

*Richard D. Kimball Co., Engineers, Boston, Mass. Member of Board of Consulting and Contributing Editors.

There was no door or opening available to remove the old boiler or to get new boilers into this boiler room.

A new and outside boiler plant was considered but the first cost seemed prohibitive and after due consideration of all factors, it was decided to enlarge and renew the boiler plant in its original location. To do this, without interruption of service, was an undertaking that required careful planning and extreme care in the various steps which changed the old inadequate, inefficient plant to a plant that has one spare boiler and operates efficiently and economically, as proved by the operating records.

How Modernization Work Was Done

As a first step, the roof of the boiler room had to be removed, and the feed pump, heater and auxiliary apparatus had to be moved to a new location to provide space for the first new boiler. After this had been done and the new setting prepared, a new boiler was moved across and over the two boilers in operation and lowered into place, connected up and put in operation. After this the inside old boiler was removed with its piping, settings, etc., and the second new boiler installed in a new setting, then the other old boiler was removed and the third new boiler with its setting, piping, etc., put in place. Each change-over was made without interruption of service except for a short period at night.

After these changes were made, the roof was replaced with a type of construction that provides ample space over the boilers for piping, repairs and cleaning. The floor of the boiler room was lowered 15 in. to give more combustion space under boilers. The same oil burners were used, the equipment being overhauled and the tank being cleaned out. All traps were overhauled, renewed and put in good working order; economizing heaters were installed to condense the vapor from the high pressure traps; meters were installed in the steam flow lines and in oil lines to check operation of the plant. The boiler room walls, ceiling and piping were painted and a system of fresh air supply was installed to make the working conditions better in the boiler room. The new plant consists of three—140 hp return tubular, brick set, fire tube boilers with new pumps, heaters, etc.

Severe Winter Proves Investment Sound

After a test of the most severe winter conditions known in Boston, the plant has demonstrated that two boilers can supply all the steam required, operating at not over 150 per cent rating at any time, thus leaving the third boiler a spare unit for repairs and cleaning and allowing for future growth.

The statement was made to the owners before work was started that if the changes could be made according to plans prepared, less oil than formerly would be burned despite the addition of 25 to 30 per cent to the load on the plant. This promise has been kept even though this past winter was unusually cold and the number of patients cared for increased over 25 per cent.

Records for the first six months operation of the new plant compared with a like period for the preceding year with the old plant are shown here; they indicate that the amount of money invested in the changes chargeable to improving plant economy will be returned to the hospital in less than one year.

There are many plants where equal or even better results can be obtained if proper study is made by a properly qualified engineer whose most vital interest is to produce a complete, economical and efficient plant at the lowest possible cost to the owners.

OPERATING RECORDS SHOW SAVINGS MADE

First 6 months of 1934 compared to the same period for 1933.

Necessary adjustments to put work on a comparative basis:

1. New seven-story hospital building having approximately 10,000 sq ft of radiation added last winter. Total radiation before this building was added was 35,000 sq ft. New building actually adds approximately 30 per cent to the boiler load, but as the building was not fully occupied the following computations allow for only 25 per cent increase in heating load.

2. Patients cared for increased over 25 per cent in 1934 over 1933.

3. Last winter was the coldest known in Boston with the lowest temperatures on record. Over a period of 6 months the degree days increased 23 per cent over the same period the preceding year.

The fuel consumption records are as follows:

	1933		1934	
Month	Oil	Degree Days	Oil	Degree Days
Jan.	55,025	843.2	58,330	1097.2
Feb.	53,704	868.4	56,900	1330.
March	53,997	908.3	49,000	926.9
April	46,885	555.	38,715	570.
May	32,500	105.	28,243	124.
June	24,703	.....	19,915	.....
	266,814	3279.9	251,103	4048.1

Actual saving of oil for 6 months = 15,711 gallons
Actual increase in degree days = 768 degree days or 23 per cent
Add for increased heating load = 29,649 gals. of oil
Add for increased population = 37,054 gals. of oil
Add for increased cold weather = 27,277 gals. of oil
Add actual saving of oil = 15,711 gals. of oil

Apparent saving for 6 months = 109,691 gals. of oil

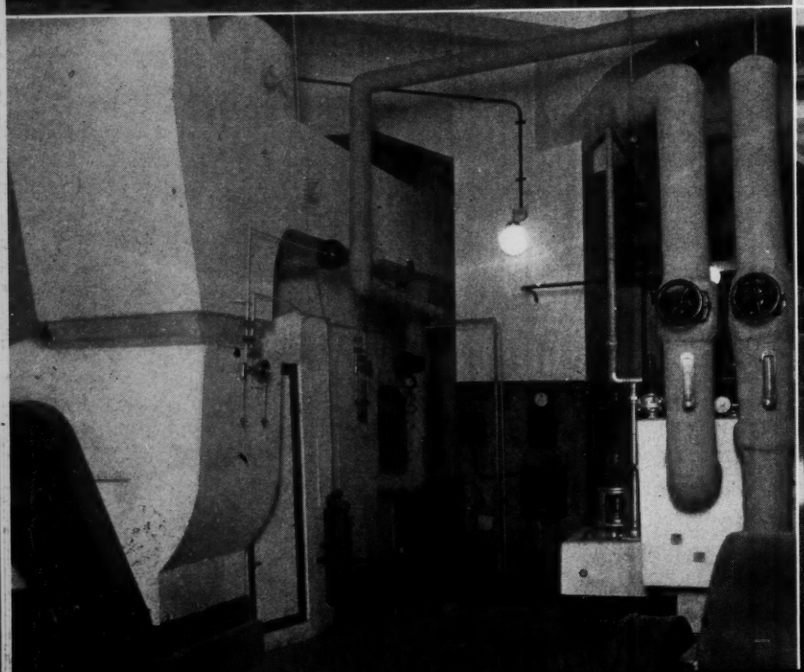
109,691 × 3½ = $3839.19 saving in cost of fuel for 6 months.

A considerable waste of water in the boiler room has also been stopped. The water bill for the first six months of 1934 was $2464.60 as compared to $3195.18 for a like period in 1933—a saving of $730.58. As a new building was added and over 25 per cent more patients cared for, there would be an apparent further saving of $798.79 or a total saving of water of $1529.37 for the first six months of 1934. This added to apparent saving of oil makes a total apparent saving of $5368.56 for the first 6 months of 1934.

Total expenses for changes were approximately $30,000.00.

In considering the savings made, however, it should be remembered that at least $6000.00 of the above total should be charged to the new building as boiler capacity had to be provided for that. Also as the old boiler plant for the whole institution was worn out and had to be replaced, approximately $18,000.00 should be charged to plant replacement. If the cost of these items were taken out, the amount of money spent for work done and chargeable to changes made only for the purpose of increasing plant economy would be returned to the hospital in considerably less than one year.

Still further study is being made of the oil burning equipment, water heating and general plant operation to make further savings.



By W. G. Hillen*

IN JAPAN

—Air Conditioning Builds Business

Air conditioning for department stores, office buildings, banks, radio stations and many other types of installations is being adopted enthusiastically by the Japanese. The author, who has been in Japan for some three years and has been concerned with a number of installations, describes several of them in this article to give a picture of the status of air conditioning there.

IN 1853 Commodore Perry was instrumental in opening the ports of Japan to commercial trade with all nations. The first American Consul in Japan, Townsend Harris, in his diary noted from the beginning the readiness, the eagerness and the facility with which Japan adapted to her use the customs, both social and commercial, of western civilization. Many of the most capable young men of Japan attended the universities of America and Europe and returned to use the best of what they had learned in changing Japan to the western ways of life. How great that change has been can only be fully appreciated by those who have lived during this period of transition.

The terrible earthquake of 1923 had a great deal to do with this change in the external appearance of Tokyo and Yokohama, two of the leading cities of Japan. Great areas in these cities were destroyed and burned to the ground, the general type of architecture existing in these cities up to that period (with few exceptions) being small wooden structures. On top of the ruins of this catastrophe Japan has built cities of wide streets in the main sections, and buildings influenced by every school of architecture in the world. These buildings are usually seven or eight floors above ground and two floors below ground. They are heavily constructed and reinforced to make them as nearly earthquake-proof as possible.

Japanese in all types of business travel extensively in Europe and America and seeing the growth of air conditioning in those countries it is natural that Japan—with her eagerness and willingness to try the new—has adopted air conditioning as standard equipment for office buildings. The necessity is readily appreciated. On very humid days, wet bulb temperatures of 80 F in Tokyo and 82 F in Osaka are encountered for lengthy periods. An additional impetus was given to air conditioning in Japan by the presentation by Willis H. Carrier, representing the *American Society of Heating and Ventilating Engineers,* of the paper on air conditioning before the 1929 World Engineering Conference in Tokyo.[1]

From the beginning, owners and architects have realized that to have a thoroughly modern building, an air conditioning system must be installed. This insures that sufficient outside air is properly conditioned and distributed throughout the building to maintain a temperature and humidity most healthful and comfortable to the occupants. In summer, the air is cooled, dehumidified and cleaned while in winter it is heated, humidified and cleaned. Another function of the air conditioning system, and a very important one, is to distribute the conditioned air through the building without drafts, thus providing a uniform temperature and humidity in all occupied zones, regardless of outside conditions. These advantages, together with the fact that air conditioning had proved its economical justification in a number of large buildings in America, greatly impressed building owners in Japan. They observed that, without air conditioning, the lower floors of a building brought lower rents than upper floors and the ground floor—generally used for a store—was not as popular for this purpose as it should have been because of the necessity of keeping windows open in hot weather, with the result that noise and dirt from the outside entered the lower part of the building. On the other hand, they observed that, with the proper air conditioning system, all doors and windows could be kept closed throughout the year, which made the ground floor extremely desirable and rent for the lower floors was higher than for the upper floors. Con-

ON OPPOSITE PAGE

Honkano Building, Tokyo, which has 75 tons of refrigeration for air conditioning

Return air grille in Takashimaya department store, Tokyo

Sanyei Building in Tokyo, with 150 ton air conditioning system

Type of air distribution used in office space of Honkano Building

Distribution outlets, Takashimaya department store

Engine room of Honkano Building

Pan outlet distribution in Japanese department store

*Chief Engineer, Oriental Carrier Engineering Co., Ltd., Tokyo.

[1]This paper was published in H. P. & A. C., November, 1929, p. 535.

vinced that air conditioning would enhance the value of their properties, a number of building owners in Japan have made large installations for various applications within the last three years.

Department Stores and Office Buildings Air Conditioned

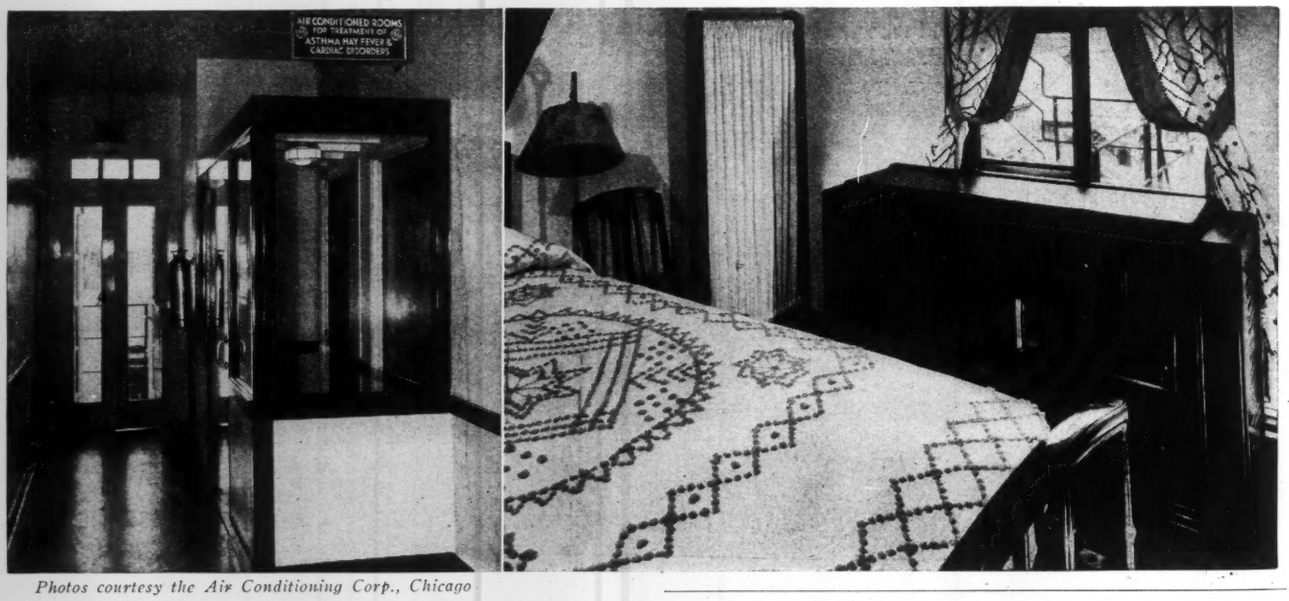
The growth of the department store in Japan has been remarkable and the largest stores in the important cities are the equal in modern equipment and methods of those anywhere in the world. In the Daimaru department store of Osaka all floors and all departments are completely air conditioned. Three 350 ton centrifugal refrigeration machines were installed with the necessary fans and dehumidifiers. The air is distributed throughout sales and display spaces by side outlets from ducts run in the columns while in the offices, the system of distribution used consists of a unit to which conditioned air is supplied and which, by an ejector effect of small nozzles, pulls recirculated air into the circuit for preventing drafts.

The Takashimaya department store of Tokyo also is conditioned throughout from basement to roof, eight stories above ground, including sales space, office, restaurants and auditoriums. Two 350 ton centrifugal refrigeration machines are used. The Sogo department store of Osaka has one such machine for cooling its basement and first floor sales space and arrangements are now being made to condition the upper floors later.

The Osaka Gas Building of Osaka is as fine an example of a public utility building devoted to offices, auditoriums, restaurant and sales space as the author has seen. Air conditioning was considered from the beginning of the design of this building, and many features were incorporated in its design to make the air conditioning system as nearly perfect as possible. Side outlets for the display rooms and pan outlets for the offices give excellent distribution. A 350 ton centrifugal refrigeration machine occupies the most prominent location in the excellently conceived machine room, which is always open to the public.

In Tokyo two more office buildings, the Honkano and Sanyei, boast conditioning systems for their complete buildings with refrigeration machines of 75 and 150 ton capacities, respectively. Work is now under way on the Kyodo Tatemono building of Tokyo (an eight-story building with offices, sales spaces and an auditorium) which will have 300 tons of refrigeration for air conditioning. The Hibiya picture show, a 1,700 seat house, of Tokyo and the Takarazuka theater, a 4,000 seat house of Takarazuka, have also just installed conditioning systems. An installation is also being made at the present time for the Osaka stock exchange, with 350 tons of refrigeration and for the Yokohama Specie Bank of Kobe with 75 tons.

Air conditioning is also being installed on 23 railroad cars, including first, second and third class, and dining cars for three streamlined trains being built by the South Manchuria Railroad. Thus, it can be seen that Japan is forging ahead in air conditioning.



Photos courtesy the Air Conditioning Corp., Chicago

HOSPITAL HAS AIR CONDITIONED ROOMS

The above illustration shows—at the right—an air conditioned private room at the Edgewater Hospital, Chicago, the unit being a self-contained type for year-around use. The view to the left shows the glass vestibules forming the entrances to the air conditioned rooms, installed to prevent the entrance of unconditioned air. The air conditioned rooms are used in the treatment of asthma, hay fever, and cardiac disorders.

Air Conditioning in the Treatment of Pollen Asthma—a Correction

In the article "Air Conditioning in the Treatment of Pollen Asthma," published in the August, 1934, issue of H. P. & A. C. two errors occurred in the figures for velocity of air through the filters. On page 331, the third sentence should read: The air velocity through the filters is 28.6 fpm. The sixth sentence should read: The air velocity through these filters is 35.1 fpm.

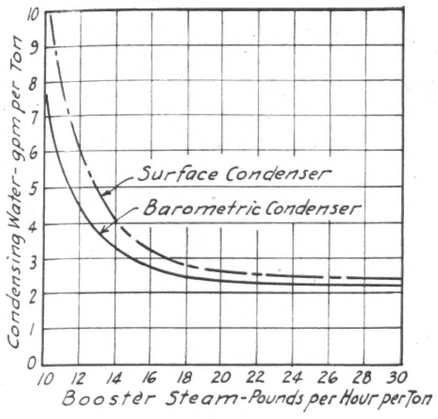


Fig. 1—Comparison of performance—steam jet vacuum refrigerating equipment, 60 F condensing water, 100 lb gage steam, 45 F chilled water

Air Conditioning Operating Cost Reduced by Efficient Use of CONDENSING WATER

By George T. Condron*

THE possibilities of reducing air conditioning operating expenses through the most efficient possible use of the condensing water for the refrigerating compressor are such as to warrant a careful study in each case. One such possibility was presented in the August H. P. & A. C. in an article by A. A. Browne.[1] Another possibility some times present in the case of steam jet vacuum equipment involves the use of a barometric condenser instead of a surface condenser. More efficient use of the condensing water is obtained in a barometric condenser since the terminal difference (*i. e.*, difference between the temperature of the water leaving the condenser and the temperature corresponding to the vacuum in the condenser) is only 2 F as against 5 F in a surface condenser. In addition to the improved operating characteristics—see Fig. 1—the first cost of the installation will be less because of the relatively lower cost of the barometric condenser. The chief limitations connected with the use of the barometric condenser are: (1) non-recovery of the condensate; (2) at least 35 ft height required from bottom of condenser to the tail-pipe discharge, unless tail pipe discharges through a pump capable of providing the suction; (3) greater pumping head for condensing water in the case of a cooling tower or spray pond.

Hotel Needs Refrigeration for Comfort Cooling

An interesting possibility recently came up in a case where additional refrigerating capacity was required in a hotel for use in conection with comfort cooling. The plant already contained a general purpose carbon dioxide refrigerating installation of 38 tons capacity. It was desired to install 63 tons additional capacity for comfort cooling only.

The use of steam jet vacuum equipment was contemplated and original proposals were based on the use of 6⅔ gpm per ton of condensing water from a cooling tower at an assumed temperature of 85 F (Fig. 2). The total quantity of water available at the condenser was limited to the increased capacity obtainable through conversion of the natural draft cooling tower serving the carbon dioxide condenser to forced draft. The total steam consumption, primary booster plus evactor, under these conditions would have been 38.5 lb per hr per ton.

The natural draft tower was already handling approximately 325 gpm which was used through a 4 F rise in the carbon dioxide condenser. Thus, the added requirement of 420 gpm was stretching the capacity of the rebuilt tower to the maximum, or beyond. However, a total capacity of 650 gpm could be safely anticipated from the rebuilt tower.

The most efficient use of this 650 gpm of condensing water could be had by passing the entire quantity through both condensers in series, Fig. 3. The first use would logically be through the carbon dioxide condenser where the lowest possible temperatures are always of vital importance. Doubling the water flow in this condenser would reduce the temperature rise to only 2 F. With operation as close to the critical temperature of carbon dioxide (87.8 F) as it was at times in this plant the 2 F reduction in the outlet temperature of the condensing water would be very helpful. In the case of the primary condenser on the steam jet vacuum refrigerating equipment, increasing the water flow from 420 gpm to 650 gpm would decrease the temperature rise from 15.7 F to 8½ F, taking into account the reduced steam consumption at the primary booster. Thus, even with a 2 F higher entering temperature, the temperatures of the water leaving the condenser—which temperature establishes the condenser vacuum—would be 5.2 F lower.

The total steam consumption, primary booster plus evactor, under these improved conditions would be 30.5 lb per hr per ton. The reduction of 8 lb per hr per ton in the steam consumption would result in a saving of over 20 per cent in the operating steam cost. The reduction of the quantity of water pumped over the tower (from 745 gpm to 650 gpm) would also result in over 12 per cent saving in the pumping cost. In addition to these savings in the operating cost for steam and pumping, there would be a small reduction in the power cost at

*Mechanical Engineer, Chicago, Ill.

[1]"Save in Air Conditioning Cost," by A. A. Browne, HEATING, PIPING AND AIR CONDITIONING, August, 1934, pp. 344-345.

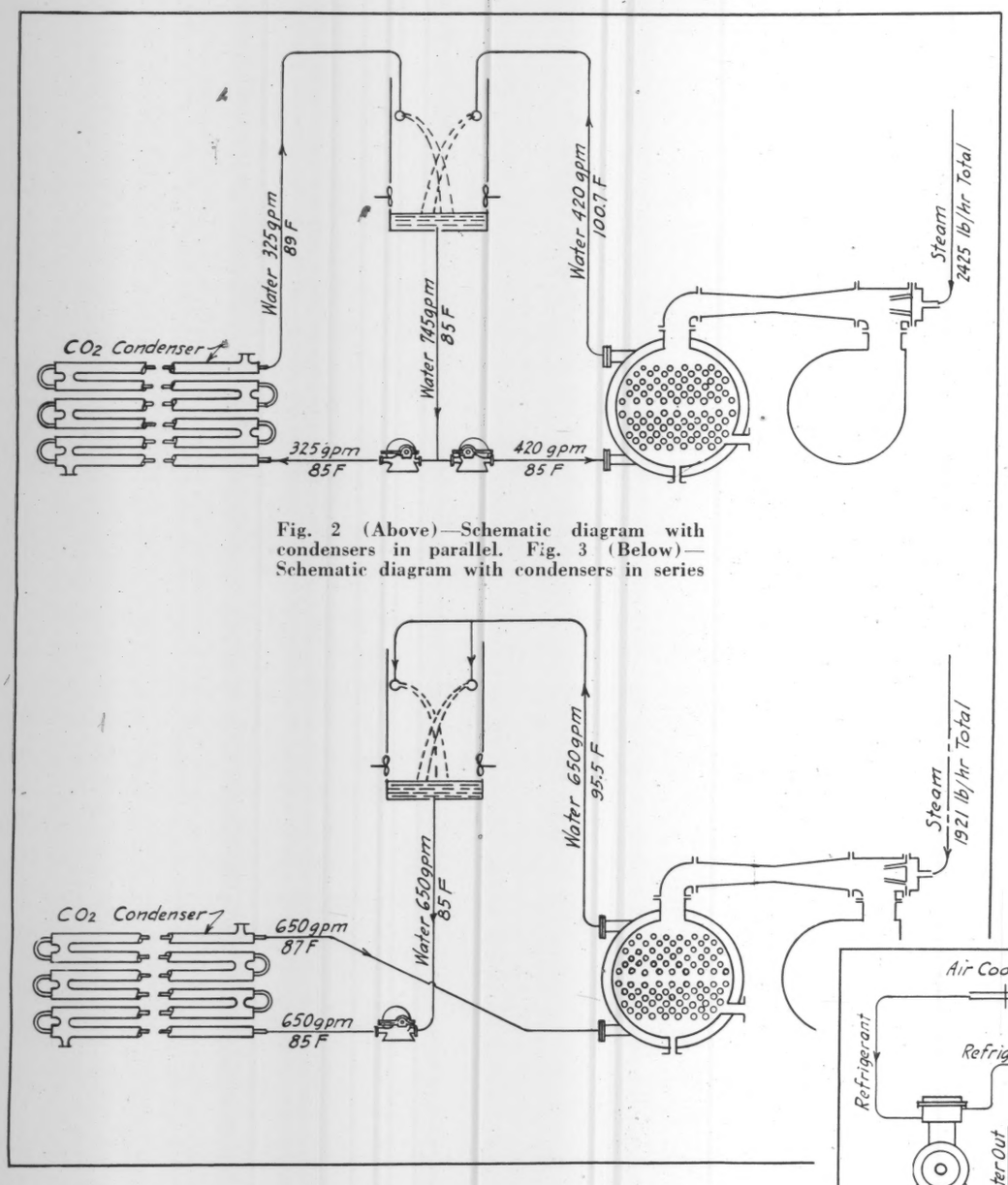


Fig. 2 (Above)—Schematic diagram with condensers in parallel. Fig. 3 (Below)—Schematic diagram with condensers in series

the carbon dioxide compressor, and an improvement in its performance under the most severe conditions.

Use of Air Precooler

Another possible "double use" of condensing water is present in the case of compressor type refrigerating units when the condenser cooling water temperature is 10 F or more below the temperature of the air entering the cooling coils. Under these conditions, the condensing water may be passed through a counterflow air precooler placed ahead of the main air cooler served from the refrigerating machine, Fig. 5.

In the case shown the air circulation is taken as 1680 lb per minute with 96 gpm of condensing water available at 55 F, and the refrigerating load at 60 tons in order to parallel the previously mentioned article in the August H. P. & A. C. The water will be capable of providing 34 tons refrigerating effect in the precooler, with a 9.25 F rise. Thus the required capacity of the mechanical refrigerating installation will be reduced to 26 tons. The increased "gpm per ton" available at the condenser more than offsets the higher temperature at the entrance to the condenser. Thus, the horsepower per ton remains virtually unchanged, but with the reduction in capacity, the total horsepower required will be reduced in the ratio of 26 to 60, better than 51 per cent.

The arrangement without the air precooler is shown in Fig. 4.

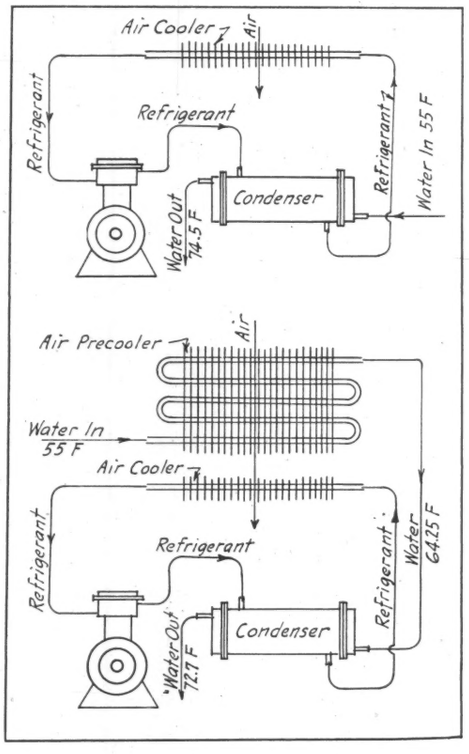


Fig. 4 (Above)—Schematic diagram without air precooler. Fig. 5 (Below)—Schematic diagram with air precooler

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A WEALTH of information on the design, installation, operation and maintenance of industrial piping systems has been made available in the pages of HEATING, PIPING AND AIR CONDITIONING each month. Although these articles have been indexed in summary form in the regular volume index published each December, the selected listing presented here of those articles of particular reference value will be helpful to the engineer or contractor needing data on the piping of high and low pressure steam, water, air, oil, gas, hydraulic power, refrigeration, process liquids, viscous materials, semi-solids, etc.

Files of HEATING, PIPING AND AIR CONDITIONING are available in many company, society, and public libraries. In some instances, copies of articles can be furnished without charge to readers of H. P. A. C. by the publisher. Where copies of individual articles are not available, back copies of the particular issue containing the article may be purchased for 50c. The articles listed here and marked with an asterisk (*) are available also in the book "Industrial Piping."

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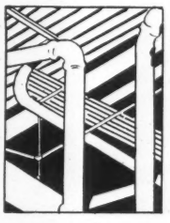

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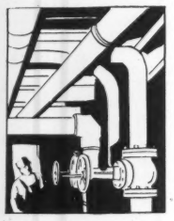

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Headquarters, Buffalo
Meets: Second Monday in Month
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425 Woodbridge Ave.
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332 Waverley Rd.
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The Nature of Ions in Air and Their Possible Physiological Effects

By **Leonard B. Loeb,† Berkeley, Calif.**

(NON-MEMBER)

THE recent focus of interest of engineers on the problems of air conditioning has raised the question as to the relative importance of various constituents of the atmosphere and their influence on the well-being of those breathing the air. Because of the general ignorance concerning the ionic constituents of the air, it is not unnatural that many persons should have ascribed somewhat miraculous powers to these constituents.[1] As a result, efforts have been made to invoke the gaseous ions in an attempt to explain certain of the less clearly defined influences observed. Needless to say, studies of such questions involve very carefully controlled experiments in which it is particularly difficult to eliminate and control the variables. The results are therefore to be regarded with a great deal of caution in view of the facts which are to follow. Actually the experimental investigations of recent years have fairly well clarified the understanding as to the nature of electrical carriers in gases so that definite conclusions as to their influence in air conditioning can be drawn. It is the purpose of this paper to present the facts as they are known today and to draw the obvious conclusions.

Carriers of electricity in gases, notably in mixtures such as atmospheric air, can be divided into three groups. These are the large or Langevin ions, normal ions, and free electrons. Early investigations of the large ions, notably the studies of Pollock, [2, 3] have shown that these ions consist of material particles, dust or liquid droplets which in one way or another have acquired a charge. Such particles, if solid, are usually covered with a condensed film of water vapor[2] whose presence and thickness depends on the degree of saturation of the air, and the nature of the particle (*i. e.* whether or not it is hygroscopic). As determined from their mobility (*i. e.* velocity in unit field) they vary in size from 10^{-7} cm in diameter on up (*i. e.* from aggregates of some thousands of molecules to visible particles). The number present varies with the condition of the atmosphere (*i. e.* on the amount of material in suspension) and on the ionic content of the air or else on the origin of the particles. If the particles are formed by the processes of combustion, by the spraying of liquids or by the agitation of material particles such as in dust storms in dry air, the percentage of charged carriers will be considerable. In the process of spraying liquids in general, it is believed, and in the case of water in particular it has been observed,[4] that the smallest particles are predominatingly negatively charged. In a recent study by Chapman[5] on drops of liquids which are generated by spraying and can be observed in a Millikan condenser, the signs of charges are independent of drop size and are the greater the larger the drops and the higher the dielectric constant of the liquid. Pure paraffine oil gives a few unit charges per drop for the smallest drops (about 3×10^{-5} cm diameter) and nitrobenzol yields some hundreds of charges per drop for the largest drops (some 4×10^{-4} cm diameter). In all but paraffine (where a few uncharged drops were found) practically all drops observed from 10^{-5} to 5×10^{-4} cm in diameter were charged and no one sign predominated. Whether the negative predominance on very minute drops (10^{-7} cm diameter) observed by Lenard and his school for water is universal for all liquids is yet to be determined. In the case of the very minute water drops only one in approximately 10^4 is negatively charged, which contrasts markedly with the case for the larger drops. The dusts and condensed vapors from flames and chemical processes have unquestionably a considerable number of charged particles of both signs. It is probable that in these cases the values of the charges per particle are small in number since they result from the picking up of ions (which are largely singly charged) or electrons from the reacting gases. Large particles are again more likely to have the more charges as they have a greater capacity and a larger collecting surface. In sand and dust storms the particles are charged through friction. The charges acquired are usually very high per particle and if the air is dry and turbulent the numbers are also very large.

In *ordinary* air unless the humidity is low and turbulence is very great, the large ions are few in number. Doubtless some of the particles occasionally pick up charges from the very few ions normally present and become charged. The majority are uncharged. Masses of condensed water vapor such as mists or fogs far from industrial contamination are largely uncharged. Sea fogs, while containing notable amounts of dissolved salts from spray action, show little indication of charge since the natural ionization of the air at sea is distinctly smaller than over the land. Mists formed inland which contain as nucleii particles of dust and products from industrial activity may be somewhat more highly charged, but their charges are minute compared to those in dust storms.

Whether the presence of charges on solid or liquid particles in the atmosphere exerts any physiological action is not known but seems highly questionable. These particles are inhaled with the air and either reach the mucosa of the respiratory tract or enter the lung cavities. All these regions of the body are covered with a conducting liquid film which either permits the neutralization of ions of opposite sign or allows the charges, if of one sign, to leak off to ground through the body; for the body, regarded from the point of view of small

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quantities of static charge, such as under consideration, is a fairly good conductor. If ions of one sign only reached the lining of the lungs, they would of course pass a current through the tissue walls on their course through the body to ground. Such galvanic currents in cells, if of sufficient magnitude, could produce physiological effects through electrolysis. These static currents are, however, of such magnitude that even were the ions all of one sign (a condition rarely realized), the effect could never be noticed, since the amount of solid or liquid matter required to introduce charges of any magnitude must in themselves produce pronounced and masking physiological effects. This conclusion becomes obvious if one realizes that if 1 cm^3 of dust particles of 10^{-4} cm diameter were inhaled in 100 seconds and if 1 per cent of these were all of the same sign and charged to 1000 E.S.U. each (a not unlikely charge value in a dust storm though the predominance of sign does not exist) the current passing through the body would be about 2×10^{-8} amperes and the current density (as this is spread over an enormous area of mucosa) would be so small as to produce no noticeable physiological action even if it all passed through the epithelial cells. On the other hand, what the physiological effects would be following the inhalation of uncharged dust at the rate of 1 cm^3 in a minute and forty seconds can easily be imagined. Similar reasoning can be applied to sprays of such a harmless substance as water where, however, it is found that only one in 10^4 of the minute droplets is predominatingly negatively charged and that to only unit charge. One is thus led to conclude that the physiological effects produced in the inhalation of large ions must be immeasurably small compared to the effects produced by the accompanying solid or liquid carriers on the respiratory tissues. As regards the ions to be obtained in inhaling fumes from chemical reactions such as combustion, it is clear that the ions, which are far less dense than in the cases previously cited, would be accompanied by such amounts of toxic substances that further discussion is unnecessary.

Normal ions are produced in air as a result of the actions of various radiations incident on air molecules or solid particles in contact with the air. These radiations consist of cosmic rays and their secondaries (always present but very few in number), gamma rays from radioactive bodies, X-rays, and ultraviolet light. Gamma radiation is always present in some amount from the radioactive constituents present in the earth and air, but is relatively weak over the ocean. X-rays normally are not present in any quantity except in laboratories. Ultraviolet light is present in sunlight but the wave lengths are too long to ionize the air appreciably at the surface of the earth. Terrestrial sources such as quartz mercury arcs or open arc lamps give some small amount of radiation capable of ionizing the gas molecules; these arcs also are capable of causing fairly intense electron emission from metal surfaces. Ultraviolet radiation can thus be neglected as a source of atmospheric ionization under usual circumstances. In addition, the alpha and beta rays of radioactive substances can ionize the air very effectively. They come from emanations of radium and thorium present in the ground in minute amounts which escape as gases from the soil. These account for some 6 to 14 of the ions formed per cm^3 per second in ordinary air over the land, while cosmic radiations account for some 1 or 2 and gamma rays for 2 to 4 of the ions formed during the same time. The presence of electrical discharges, lightning, corona from high tension lines, sparks, etc., produces intense ionization near the ionized paths. Also the gases from flames and near certain chemically reacting gases may have a relatively high content of gas ions. Thus aside from the air in the neighborhood of artificial specifically ionizing agents, the normal atmosphere is little ionized. Even in industrial centers, the rate of normal ion production in the air rarely exceeds 20 ions per cm^3 per second, and is more nearly 10. Owing to diffusion and recombination, these ions disappear at a rate which is not negligible so that the ionic content of the air is normally never very much greater than some 2000 ions per cm^3, and usually about 1000. In fact, even with intense X-ray ionization in the laboratory, it is hardly possible to exceed concentrations of 10^6 or 10^7 ions per cm^3 at any one time. While arcs and electrical discharges have far higher ion concentrations in their paths, this ionization can not be widely diffused through the air in high concentrations. X-ray ionization thus probably furnishes the greatest volume ionization, without great contamination of foreign particles, obtainable. If the ions are produced in the air, the positive and negative ions appear in equal amounts, while ionization produced from solid surfaces by X-rays will have primarily negative ions.

The nature of the normal ions in air is today fairly well known. Ionizing agents detach from the oxygen or nitrogen molecule as a rule a single electron.[6] On the average this electron has a considerable excess of kinetic energy given it by the ionizing agent and thus escapes rather far from its original atom in terms of the scale of atomic dimensions. Except at pressures of hundreds of atmospheres, the electron very rarely, if ever, regains its parent molecule. It usually moves about quite rapidly in the gas, gradually losing its excess energy until a fortuitous encounter with an oxygen or some complex molecule causes it to attach to that molecule to form a negative molecular ion.[7] Not much is known about this process except that in O_2 it takes some 10^4 impacts on the average to attach, although this figure varies with its velocity,[8] increasing as the velocity increases. The heat of formation of such an ion is of the order of one volt of energy,[9] (*i. e.* about one-fourth the heat of dissociation of H_2) and presumably gives a radiation well in the red end of the spectrum. The positive molecular remainder after the electron has left it may dissociate in some gases. Usually it does not. If multiple charged by the occasional loss of two or more electrons in the ionizing process, it will in a short time steal electrons from a neutral molecule making as many singly charged ions as it had positive charges.[6] While multiple charged ions are sometimes formed, there is no evidence of their existence after the thousandths of a second or more during which ions are studied. This is not strange as ions make some 10^9 impacts per second in a gas and even if only one impact in 10^6 resulted in some event, the event would occur within 10^{-3} seconds. More often if much impurity is present, the O_2^+ ion may steal an electron from some molecule of slightly lower ionizing energy in an impact giving a new charged nucleus and O_2. This has been observed to occur in gases by Kallmann and Rosen,[10] and for ions by Luhr.[11]

As is well known, ions in solution have very specific

electrochemical affinities for some molecules, making the so-called complex ions. Such ions as the NH_4^+, the $Cu(NH)_{3\,4}^{++}$ and the $Cu(CN)_2^-$ ions are common examples. Studies of the behavior of gaseous ions in mixed gases and of the aging of ions have demonstrated beyond doubt that such combinations also occur in gases. Thus it does not surprise one to find the positive ion attaching readily to NH_3 or RNH_2 compounds to form complex ions in gases. This also occurs for these ions with ethyl ether and the cyanides.[12] In contrast, the negative ions pick up molecules of Cl_2, alcohols, ROH and both ions pick up HCl and SO_2. It was long believed, due to the fact that observed ionic mobilities in gases were about one-fifth what one would expect did their charge not affect their motion by attracting neutral molecules, that the ions were *clusters* of some 6 to 30 neutral gas molecules. The discovery of the formation of the specific ions described above and much other evidence has made the large cluster ion seem unlikely,[13] and it is probable that the ions are a positively or negatively charged molecule which in the right environment has been able to pick up some especially powerfully attracted impurity to form a complex. From the stability of these complex ions and other knowledge, it is unlikely that many more than 3 or 4 of the active molecules enter into the ion complex. This is in essence not a cluster. The further decrease of the mobility formerly ascribed to a large cluster is completely accounted for by the impaired motion of the ion through the gas, in view of its dielectric attraction for the gas molecules, which is, however, too weak and non-specific to cause clustering. The Debye-Hückel theory of strong electrolytes in solution is based on an analogous viewpoint. This fact is borne out admirably in recent experiments of Tyndall, Powell and Brata.[14] Thus the low mobility can be explained by the inverse fifth power law of dielectric attraction, while the work in mixed gases, aging, the differences in mobility of positive and negative ions in different media, and perhaps their condensing power in cloud chamber experiments are conditioned by complex ion formation.

One may well ask what one can expect to find in the complex ion groups in air. This depends upon age, on impurities present and on the intensity of ionization in air. Luhr[11] has observed the masses of ions in very pure N_2 and O_2 very shortly after formation. In N_2, the ion will, if given time, add another N_2 molecule or an N atom, giving N_4^+ and N_3^+. In O_2 one has only O_2^+ and a few O^+ ions. In air these ions occurred as well as those of the oxides of nitrogen. The transfer of charge noted above was found to occur from O_2^+ to NO, NO_2 and N_2O and especially to water vapor present. This referred to ions some 10^{-6} seconds after ionization. If, however, NH_3 or Cl_2 or SO_2 are present, even in traces, these simpler complexes give way to the much more stable complexes of NH_3, Cl_2 and SO_2. In fact it has been shown by Bradbury [15] that the degree of purity essential for mobility studies on uniform and reproducible ions requires techniques which transcend any chemical techniques known. For example, O_2 prepared by methods used in the most accurate atomic weight determinations were useless for ion work and other techniques had to be resorted to. Since 10^9 impacts occur in one second if only one part in 10^6 of a substance is present which can replace another molecule of a complex ion in one out of 10 impacts, a mobility method giving results on ions 10^{-2} seconds old (most methods used take this time) will show the more stable impurity complex as predominating. Hence in a gas like air, the ions will be progressively changing the nature of their complex such that in sufficient time all negative and positive ions will be complexes having the largest and more bulky but stable impurities as companions. Such progressive aging has been observed,[16] and the tendency of the larger and more bulky organic molecules to form the more stable complexes is an established fact.[12]

Thus in air all one can say is that the ions will consist of groups of varying ages and complexity whose most frequent nature will depend on the stability of the complexes possible and the impurities present. As air is a complex mixture which under the intense ionizing radiations has the chance of forming compounds having high affinities, it is not surprising to find that such products influence the mobility markedly. This has been observed by Erikson[17] and by Varney.

When one considers the physiological effect of normal ions, one must distinguish two possibilities: the effect of the charge on the mucosa and the tissues, and the effect of the foreign molecules brought into the body by the complex. As has been indicated in the case of the large ions, the effect of the charge cannot be significant. This is especially true since the greatest charge density which can be effectively produced and maintained conveniently in air is 10^7 ions per cm^3, which would give currents of 3×10^{-8} amperes if two liters of air were inhaled per second and all ions *were absorbed and were of one sign*, which does not occur. Ordinarily, of course, one must realize that normal air has 1000 or less ions per cm^3 in a total of 2.7×10^{19} molecules of gases composing the air. Hence even impurities which cannot be detected chemically, *i. e.* present to one part in 10^7, will have 10^{12} molecules present in contrast to 10^3 ions. This makes the effect of the variation of ionic content in normal air as a health factor seem ridiculous in the extreme.

In discussing the companions of the ions, one faces another question. Could one control the age of the ions breathed and the superchemical purity of the air, one might get a selective group of molecules into the respiratory tract. The amounts would, however, be exceedingly small compared to the quantities of the same products which could be inhaled by introducing one part per million of the chosen molecules into the air that is inhaled. Hence the value of gas ions and in fact their effect, would be ridiculously minute. Experiments in this direction are hardly needed as simple calculation reduces the question to one of absurdity.

On the other hand, an attempt to study this question experimentally on human subjects (as has been done[1]) ceases to be one of absurdity. It is exceedingly dangerous to health. The danger lies in the following fact. While ions are relatively unstable entities (*i. e.* they diffuse, give up their charge to solid particles and rapidly recombine), all ionizing processes in air give rise to chemical reaction products of marked physiological activity which are millions of times more stable. Thus in one second, one-half of the million ions initially created in a cm^3 of air have recombined. In the same cm^3, while 10^6 ions were formed, it is not rash to estimate that some 10^7 or 10^8 molecules of various sorts such as ozone, N_2O_4, NO_2, NO, etc. have also

been formed. These are stable, even ozone lasting many minutes. It is seen then that in an attempt to create a few million ions per cm^3 and to maintain that concentration for inhalation experiments, the air in a very few minutes is charged with concentrations of violently reactive gases transcending ion concentrations by many thousands of times. That such must be the case is seen when one realizes that ionization is a very inefficient process; for about half the energy put into ionization in air (16 volts as against 33) goes into ionization, while the rest is spent in activating the air and energy of activation for most chemical processes is a small fraction of the ionizing energy. Finally, even the more unstable chemical products are thousands to millions of times more stable than the ions.

Concerning the danger of these products to human health when taken into the lungs, little need be said. Ozone was at one time heralded as a vitalizing and health-giving product, a *cure-all* for disease and a wonderful disinfectant. The medical profession has long ago abandoned ozone as a particularly irritating and dangerous compound.[19] The small amount of ozone created by a quartz mercury arc in a confined room during an hour or two a day for a few weeks has been the cause of serious chronic respiratory afflictions in several cases to the knowledge of the writer. Ozone is a germicide and thus as destructive of human tissues as it is to bacteria. As regards the oxides of nitrogen, the physiological effects, especially of those leading to nitric acid formation, are self-evident. Even moderate exposure to such products as produced by the high tension brush discharged from improperly protected power lines in a confined space leads inevitably to the more serious pulmonary infections such as pneumonia. In fact, it should be emphasized that the present occasional practice of *purifying* the air of theaters and public halls[18] by means of O_3 and its accompanying nitrogen oxides or by Cl_2 gas should be terminated until very much more study has been made of the effect of small amounts of these substances in air on health.

As regards free electronic carriers, little need be said in reference to their possible physiological action in air. The free electrons, no matter how generated, in some 10^4 or less seconds will attach themselves to neutral molecules to form negative ions. They do not exist in air for a sufficiently long time as electrons to be considered as a feature at all. Thus the effects which they might cause must all be included under the heading of ions which have already been discussed.

It is obvious from the foregoing that the possible physiological effects of gaseous ions as they influence the problems of air conditioning are absolutely negligible. Not only that, but any attempts to investigate such influences experimentally on human beings must not only be regarded most critically but must also be regarded as dangerous. For in order to introduce appreciable charges into the respiratory tract to produce galvanic currents of any magnitude, so much foreign material, solids (dust, MgO, etc.), liquids (sprayed water dust), or secondary reaction products such as O_3, N_2O_4 or N_2O must be taken into the lungs as almost certainly to produce pneumonia or chronic pulmonary ailments, and respiratory infections. In view of the great predominance of foreign matter in air compared to the indefinitely minute ion concentrations, the air conditioning experts would do far better to study and understand the effects of small amounts of dust, ozone, N_2O_4, SO_2, NH_3, CO_2, CO and water vapor in the air on the comfort and well-being of the inhalants, than to waste any time in considering gas ions.

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Consumers Board Asks Uniform Grade Names

Development of a model system of terms for designating grades and qualities of commodities has been undertaken by the *American Standards Association* at the request of the NRA Consumers' Advisory Board. The project is intended to eliminate misleading and confusing terms by defining exactly what each grade designation means.

The *American Standards Association* is prepared to proceed promptly with the first stage of the proposed undertaking, *viz:* conferences with producer, consumer, distributor and governmental groups concerned, whose cooperation will be essential according to P. G. Agnew, Secretary.

Code Authority of Air Valve Industry

The duly elected members of the Code Authority for the air valve industry functioning under the NRA are:

A. E. Bastedo, Burnham Boiler Corp., Irvington, N. Y.; G. E. Cage, American Radiator Co., New York; J. L. Dole, The Dole Valve Co., Chicago; R. H. Hubbard, the Beaton & Cadwell Mfg. Co., New Britain, Conn.; A. H. Magee, New York Air Valve Corp., New York; C. H. Olmsted, J. P. Marsh Corp., Chicago; H. W. Reis, W. A. Russell & Co., New York and W. K. Simpson, Hoffman Specialty Co., Inc., Waterbury, Conn.

The Ventilating Effect of a Slotted Cylinder

By **Huber O. Croft* and Theodore R. Thoren*, *(NON-MEMBERS)***
Iowa City, Iowa

SOME few years ago, the senior author was performing some experiments to determine the error introduced in the indications of Pitot and static tubes by having these tubes yaw somewhat from the parallel and perpendicular positions in wind streams in which the tubes were placed.

In some of the experiments small cylinders with a single pressure hole were inserted in the windstream perpendicularly, rotated about the axis of the cylinder, and pressures were recorded for different angles of rotation. The results of these experiments were similar to that shown in Fig. 1.

The results shown in Fig. 1 are for a 1 in. tube projected in a 2 ft diameter duct perpendicular to the direction of the flow of air. The tube had a small hole about 1/32 in. in diameter drilled radially. The tube was then rotated about its axis and the pressure recorded as the location of the hole changed. Three wind speeds are indicated in the figure, namely: 15, 22, and 29 feet per second.

Positive pressures are located outside of the heavy circle and negative pressures are found within the circle. Hence, it is seen that for this size of tube at the velocities indicated, positive pressures are found about 35 deg on both sides of the upstream position, and that the value of this positive pressure increases as the wind speed increases; and likewise that negative pressure areas occur beyond this 35 deg angle for this tube, and that the amount of the negative pressure increases as the wind velocity.

These facts are well known, aerodynamic phenomenon, but the thought occurred, why not employ this negative pressure area existing on the leeward side of a cylinder for a ventilating effect.

With this end in view, this paper presents the results of tests to determine the ventilating effect of different proportioned slots on the leeward side of different sized cylinders, and compares the results obtained with other shapes, both in an artificial wind stream and also exposed to natural weather and winds on a roof.

Description of Ventilators Used

The various slotted cylinders and ventilator types used are shown in Fig. 2 and will be referred to by the numbers indicated in the photograph.

Ventilator No. 1 is a slotted cylinder of 2 in. diameter having adjustments so that the length of the slot could be varied from zero to 12 in. long and the width of the slot could be varied from zero to 90 deg of the circumference (a projected width of 1.44 in.).

Ventilator No. 2 is a slotted cylinder of 4 in. diameter having an adjustment for slot length up to 12 in. and a slot width adjustment up to 90 deg similar to that for No. 1.

Ventilator No. 3 is a slotted cylinder of 6 in. diameter having adjustments similar to that of Nos. 1 and 2.

Ventilator No. 4 is a slotted cylinder of 8 in. diameter having similar adjustments to those of Nos. 1, 2, and 3.

Ventilator No. 5 is an 8 in. elbow which was used with the opening to the leeward.

Ventilator No. 6 is an 8 in. ventilator of a conventional type which was found to be most efficient in some unpublished tests made by one of the authors.

Ventilator No. 7 is a *streamlined,* 4 in. ventilator having a cross-section similar to an airfoil with slots on both sides; these slots could be covered over with paper for various tests.

Ventilator No. 8 is a 4 in. ventilator with vertical 12 in. slots, 1½ in. wide (projected width) with balanced flappers, so hinged that the flappers on the upstream

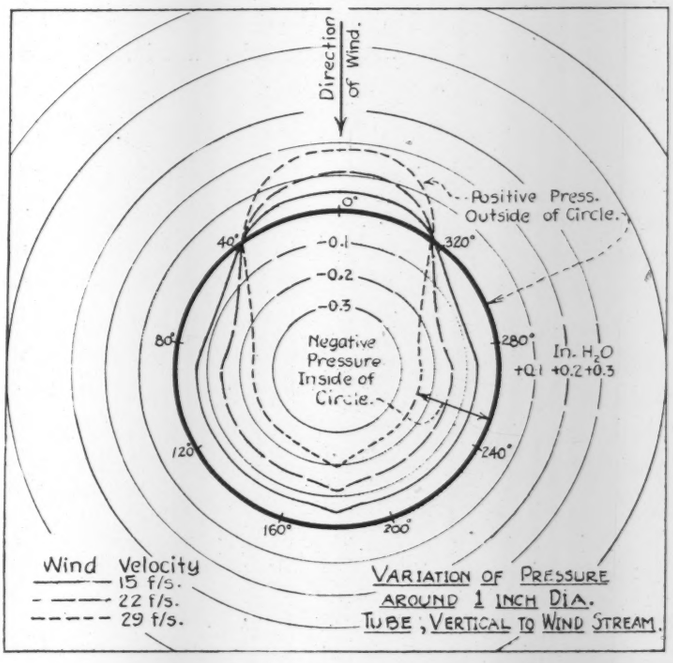

Fig. 1—Variation of pressure around a cylinder in a wind stream

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slots would close while those on the downstream slots would open. This was an attempt to adjust the opening and closing of the proper slots in accord with the momentary direction of a shifting wind.

Testing Procedure in Artificial Wind Stream

Each ventilator was installed as shown in Fig. 3 about six inches in front of a 25 in. diameter duct with the top

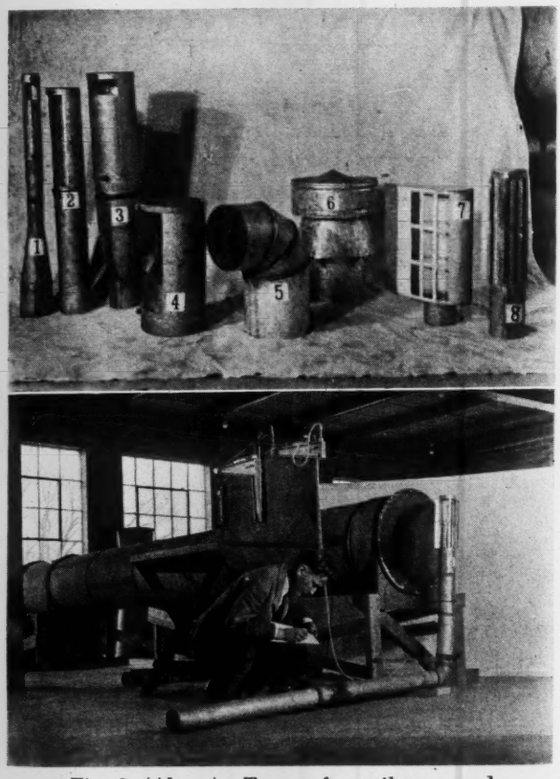


Fig. 2 (Above)—Types of ventilators used
Fig. 3 (Below)—Arrangement of experimental apparatus

of the ventilator well in the wind stream. The lower end of the ventilator was connected to a 4 in. diameter measuring tube by means of a 4 in. elbow as shown. Ventilators larger and smaller than 4 in. were connected to the same 4 in. elbow by means of an expanding or contracting adapter. The location of the ventilator with respect to the duct and the windstream was the same for all ventilators.

The 4 in. diameter measuring tube was 6 ft-4 in. long and contained an anemometer at the mid-section which could be read through a window in the tube.

The windstream velocity was obtained by a Pitot tube located at the center of the duct 10 ft upstream from the position of the ventilator. The usual Pitot traverses were previously made at different wind-speeds and the relation between the average velocity and center-line velocity obtained, so that the required corrections could be made for the Pitot readings obtained at the center-line on the actual ventilator tests.

A honeycomb was located in the duct at the fan outlet to assist in smoothing out the wind stream. An examination of the wind stream around and past the ventilators indicated satisfactory conditions.

For each test, corresponding readings were taken on the dynamic and static pressures in the duct while readings on the anemometer in the measuring tube were taken every minute for four minutes and the results averaged. The barometric pressure and air temperature were likewise recorded.

The slotted cylinders were first tested with the narrowest opening, usually 2 in. long; this width of opening was maintained constant until at least four lengths of slots at that width had been tested with a maximum length of 12 in. The width noted above is the projected width of the opening and not circumvential length.

The slot width was then increased and again tests were run with varying lengths of opening as noted above.

The projected areas of the slots for varying width and length are shown in Table 1. The identification of the slot for any particular cylinder is obtained from the code numbers which give the diameter of the cylinder first, followed by the length of slot, and then the projected width of the slot. For example:—2x8x3 would indicate the 2 in. cylinder with a slot 8 in. long with width 3 or 0.563 in. (from Table 1). *W* indicates the maximum slot opening for any given tube.

Computation of Discharge

The discharge of each ventilator was obtained from the product of the cross-section of the 4 in. measuring tube in sq ft and the velocity indicated by the anemometer placed therein.

Anemometer corrections were applied as indicated by the manufacturer's calibration. The same measuring tube and anemometer were used for all tests in the artificial windstream. For true quantitative results it would have been desirable to calibrate the anemometers in place. This was not done for these tests because the primary object was to compare the various ventilators and not to determine accurate flow values to use as a guide for design.

Results Obtained in the Artificial Wind Stream

Fig. 4 illustrates the variation of the discharge with a variation of the width of slot opening at different wind speeds and at the maximum length of slot of 12 in. It will be noticed that the discharge for each size tube tends towards a maximum.

Fig. 5 illustrates the variation of the discharge for the 4 in. and 6 in. tubes with a constant width of slot of 7 and with varying lengths of slots and wind velocities.

Fig. 6 illustrates the variation of the discharge with varying slot widths and wind velocities at a constant slot

Table 1—Projected Width of Slots on Leeward Side of Cylinder

Diameter of Cylinder in Inches	Opening No.	Projected Width in Inches
2	1	0.219
	3	0.563
	5	0.875
	7	1.219
	W	1.438
4	1	0.437
	3	1.125
	5	1.750
	7	2.375
	W	2.812
6	1	0.500
	3	1.500
	5	2.438
	7	3.438
	W	4.187
8	1	0.750
	3	2.060
	5	3.370
	7	4.500
	W	5.620

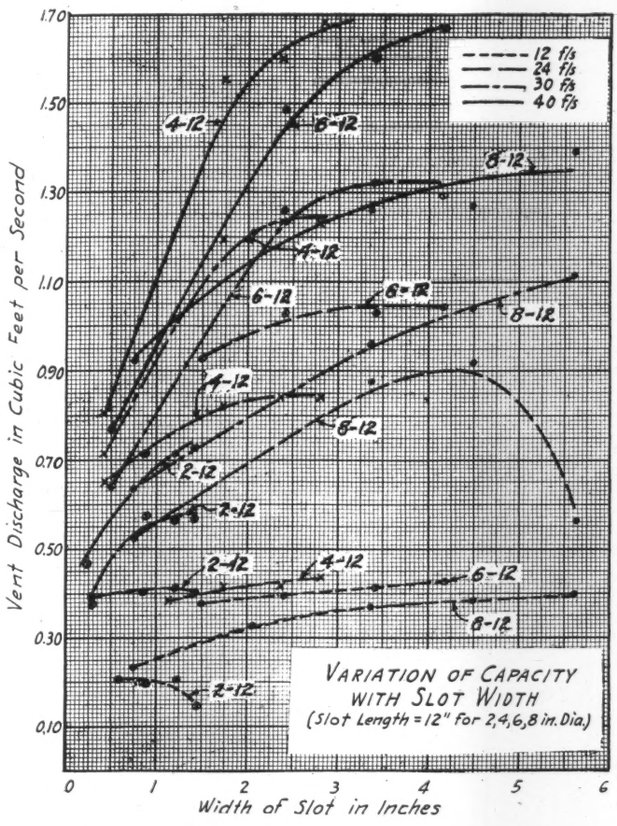


Fig. 4—Effect of slot width with full, 12 in. length of slot

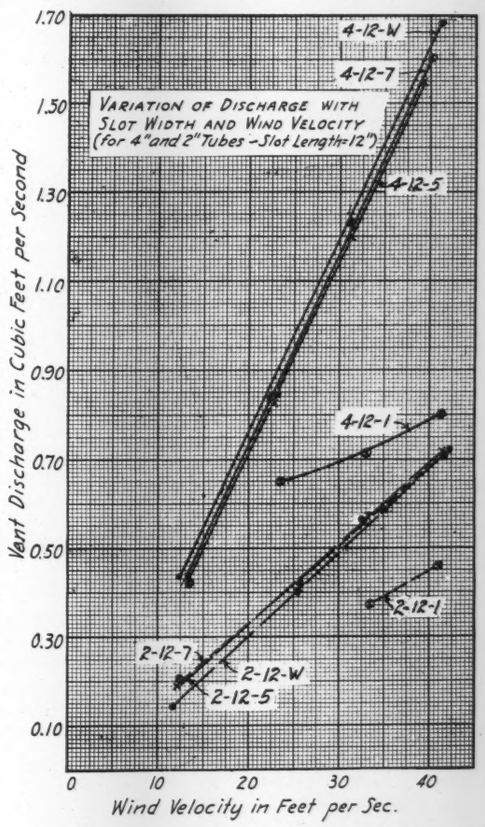


Fig. 6—Effect of slot width and wind velocity for 4 in. and 2 in. tubes at constant slot heights of 12 in.

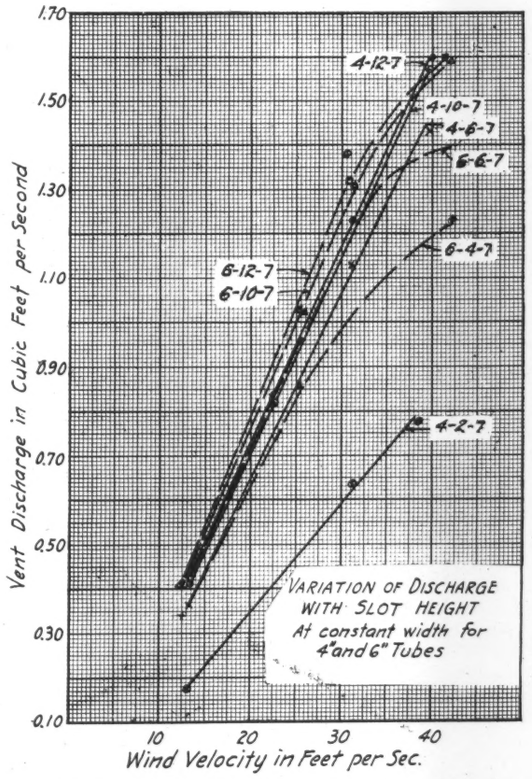


Fig. 5—Effect of slot height for 4 in. tube with constant slot width

height of 12 in. for both the 2 in. and the 4 in. tubes. Corresponding graphs were obtained for the 4 in. and 8 in. tubes and except for the latter, the results were not as consistent. In general the 8 in. tube seemed to be less efficient than the 4 in. and 6 in. tubes; this may have been due to: (*a*), the smaller tubes are inherently more efficient, or (*b*), the flow conditions around the 8 in. tube were constricted because of the larger frontal area presented by this larger tube in front of the duct, although a superficial examination with threads in the wind stream did not so indicate.

It was felt that there should be a definite relation between the Reynolds' number of the tube in the wind stream and the Reynolds' number of the slot.[1] This seemed to be true for any one sized tube, but extreme difficulty was experienced when an attempt was made to correlate the four different sized tubes by one simple expression. The relations between these Reynolds' numbers are shown in Fig. 7.

Fig. 8 illustrates the variation of the ratio, $\left[\frac{V_s}{V_w}\right]$, of the velocity of the air discharged from the slot, V_s, to

[1]The Reynolds' number of the tube in the wind stream is $\frac{DV_a\rho}{\mu}$ where D = the diameter of the tube in ft; V_a = velocity of wind stream before tube in feet/second and ρ and μ are the density and the absolute viscosity of the air in foot-pound-second units.

The Reynolds' number of the slot was taken as: $\frac{4mV_s\rho}{\mu}$ where m = mean hydraulic radius of the slot (C. S. area ÷ perimeter) in feet; V_s = the velocity of the air through the slot in feet/second; and ρ and μ are the same as above.

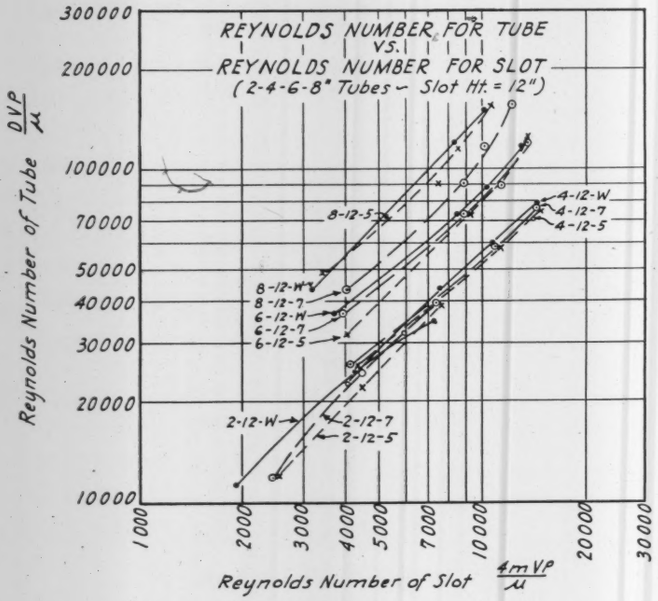


Fig. 7—Variations of Reynolds' Number of tube in wind stream with Reynolds' Number of slot

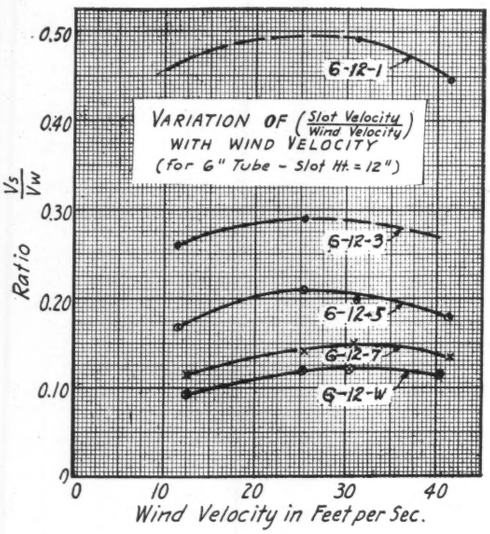


Fig. 8—Variation of the ratio of the slot velocity to the wind velocity for the 6 in. tube

the velocity of the wind stream, V_w, for the 6 in. tube at different wind velocities and different slot widths.

The characteristics of the other ventilating devices compared to those of the 4 in. tube are shown in Fig. 9. (The identifying numbers in Fig. 9 refer to Fig. 2.)

Testing Procedure for Natural Roof Ventilating Experiments

In order to determine the performance of the slotted cylinders under natural wind conditions, a supporting platform was constructed on the roof of the Mechanical Engineering Laboratory as shown in Fig. 10.

The 4 in. diameter slotted cylinder was compared to the 8 in. ventilator (No. 6 in Fig. 2). The same type of anemometer measuring tube was used for these tests as was used for the tests in front of the duct. The leader from the 4 in. slotted tube was expanded to 8 in. diameter in order that the frictional resistance in the leaders might be comparable. The 8 in. leaders curved to the horizontal plane under the roof and reduced to 4 in. for connection to the anemometer tubes. In some of the tests different anemometers were used for each ventilator, while in others the same anemometer tube was used for both ventilators. Most of the tests were run with only one ventilator in position at one time to prevent mutual interference of the wind stream.

The slotted cylinder was mounted on ball-bearings with a seal to prevent leakage around the petticoat and was provided with a vane to hold the slot in the lee of the wind.

Results of Roof Tests in Natural Wind

The results of the roof tests in natural wind for the 4 in. slotted cylinder and an 8 in. conventional ventilator are shown in Fig. 11.

Since the ventilating effect of an installed ventilator is caused partly by the *natural draft* effect due to a difference in inside and outside densities, the temperature gradients between the inside and outside air are shown on Fig. 11.

These results would indicate that the ventilating effect of a properly designed 4 in. slotted cylinder was comparable to that of an 8 in. conventional ventilator.

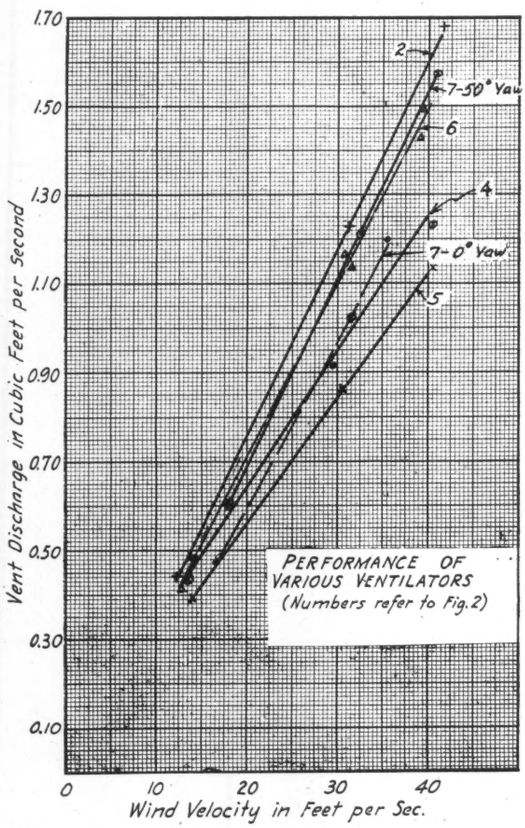

PERFORMANCE OF VARIOUS VENTILATORS
(Numbers refer to Fig. 2)
Vent Discharge in Cubic Feet per Second
Wind Velocity in Feet per Sec.
7-50° Yaw
7-0° Yaw

Fig. 9—Ventilating characteristics of various shapes

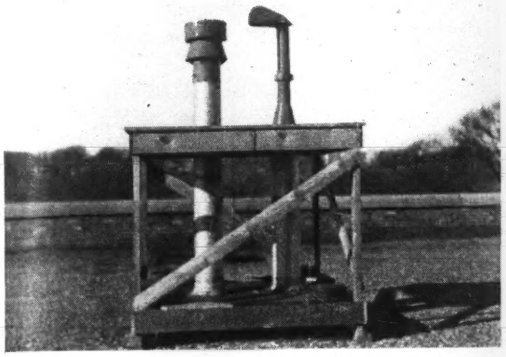


Fig. 10—Installation of ventilator for practical testing in natural wind on roof of Mech. Engrg. Laboratory

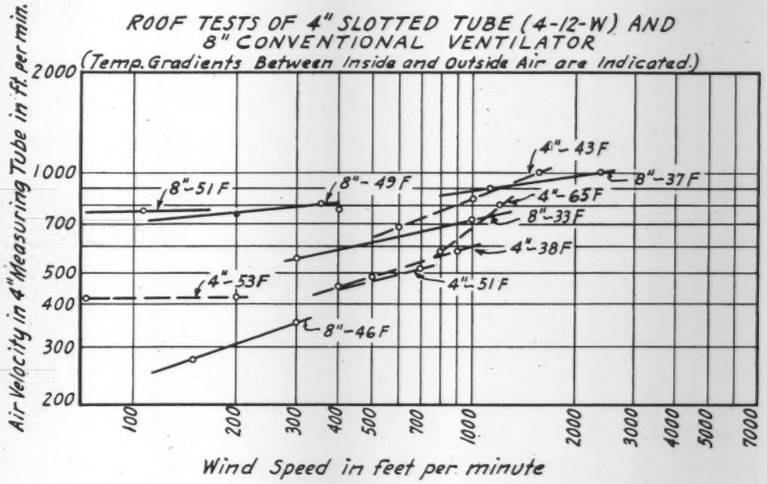


Fig. 11—Roof tests of 4 in. slotted tube and 8 in. conventional ventilator

Conclusions

(*a*) A cylinder, vertical in a wind stream, with a longitudinal slot on the leeward side provides a simple and efficient ventilator.

(*b*) This simple device can be constructed to change position with the wind in order that the slot will always be on the leeward side.

(*c*) The capacity of the device depends upon the diameter of the cylinder, the length and width of the slot, and the wind velocity. There is an optimum length and width of slot for each diameter of cylinder.

(*d*) The 4 in. diameter, slotted, cylinder has a capacity comparable to that of an 8 in. ventilator of the conventional type. Increasing the diameter of the slotted cylinder to 8 in. did not increase its capacity, however.

It would seem, therefore, that the most effective diameter of the slotted cylinder, as a ventilator, is between 4 and 8 in.

Alexander Zeck

In the death of Alexander Zeck at his home in Morgantown, W. Va., on August 15, 1934, the Society lost one of its oldest members. Mr. Zeck first joined as a Member in 1904 and was extended the privileges of Life Membership in 1929.

Mr. Zeck was born at Johnstown, Pa., July 1, 1852, and was brought up by his maternal grandfather, Frederick Marbourgh. He attended the public schools and at the age of 15 entered the employment of the Allegheny Railroad. Two years later he became a passenger engineer for that company and in this capacity was transferred to the Baltimore and Ohio Railroad.

In 1875, he moved to Grafton, W. Va., where he took an active interest in the industrial life and forwarded the organization of the Tygart Valley Ice Co. of which he was manager. The manufacture of the first artificial ice in that city proved successful and, after disposing of his interest in this plant, Mr. Zeck became engaged in the contracting business, specializing in steam heating, power plants, and general steam engineering. He installed the heating systems in many important buildings in West Virginia, Ohio, Maryland and Pennsylvania, including the buildings of the University of West Virginia and the Morgantown High School.

Mr. Zeck became a resident of Morgantown, W. Va., in 1916, coming there with his son, Fred V. Zeck, with whom he had organized the company of Alex. Zeck & Son in Grafton, W. Va., in 1904.

Mr. Zeck, who had been in failing health for the last six months, is survived by his widow, Mrs. Edna Wells Zeck, and his son, Fred V. Zeck, of Morgantown, one daughter, Mrs. John W. Thayer, of Parkersburg, W. Va., four grandchildren and one great grandson. He was buried in Grafton, W. Va., on August 18, at Bluemont Cemetery, where services were conducted by the Grafton Lodge No. 15 A F & A Masons of which he had been a member for many years, assisted by the Rev. Roy Hashinger of St. Paul's Lutheran Church.

St. Louis

September 19, 1934. After dinner at Joe Garavelli's, De Balivere and De Giverville, the meeting was called to order by Pres. Paul Sodemann with 28 members and guests present.

J. W. Cooper, chairman of the Program Committee, outlined plans for future meetings. In October, J. L. DeNeille, president of the *Heating, Piping & Air Conditioning Contractors National Association* will be the speaker and a sound motion picture relating to the Federal Housing Administration will be shown. A meeting to be held in conjunction with the Engineers Club will take place in November, when Pres. A. C. Willard of the University of Illinois will be the Chapter's guest and speaker. In December the annual meeting and election of officers is scheduled. President Sodemann reported for C. R. Davis, chairman of the Entertainment Committee, and spoke of the possibility of Ladies' Night and other entertainment at the annual meeting.

D. J. Fagin, chairman of the Membership Committee, stated that he had several good prospects for membership and that at the next meeting he hoped to be able to report their applications filed.

G. B. Rodenheiser, in the absence of C. A. Pickett, chairman of the Educational Committee, told of improved registration for all courses at the Ranken School, with the exception of those connected with the building trades. Air conditioning will be added to the heating and ventilating course as a third year subject.

A letter from E. N. McDonnell, of the Guide Publication Committee, asking cooperation in developing the catalog data section of THE 1935 GUIDE, was read by President Sodemann.

The meeting was then turned over to J. W. Cooper, chairman of the Program Committee, who led a very interesting discussion on THE 1934 GUIDE.

NOMINATIONS FOR 1935

The Nominating Committee appointed to select candidates for Officers of the Society for the coming year, 1935, submits the following list of nominees:

For President:
JOHN HOWATT, Chicago, Ill.

For First Vice-President:
G. L. LARSON, Madison, Wis.

For Second Vice-President:
D. S. BOYDEN, Boston, Mass.

For Treasurer:
A. J. OFFNER, New York, N. Y.

For Members of the Council:

Three-Year Term

J. F. MCINTIRE, Detroit, Mich.
ALBERT BUENGER, St. Paul, Minn.
F. E. GIESECKE, College Station, Texas
W. E. STARK, Cleveland, Ohio

Respectfully submitted,

NOMINATING COMMITTEE,

W. R. EICHBERG, *Chairman;*
W. G. BOALES, *Acting Secretary.*

In accordance with the provisions of the Amended Constitution, as given, ballots containing the names of the above candidates will soon be sent to the membership for voting upon prior to the Annual Meeting in January.

Art. B-VIII—Section 10. The Nominating Committee shall consist of one (1) member eligible to vote designated by each Chapter, or his alternate also appointed by the Chapter. The Secretary of each Chapter shall certify to the Secretary of the Society on or before January first the names of the member and alternate selected.

The Committee shall meet at the Annual Meeting of the Society at the call of the Secretary of the Society and shall effect its own organization and elect its own Chairman. At the Semi-Annual Meeting of the Society, if possible, the Nominating Committee shall select the nominees for the ensuing year for the offices of President, First Vice-President, Second Vice-President, Treasurer, and four (4) members of the Council. In any event the names of the nominees shall be certified to the Secretary of the Society before September twentieth, with the written consent of each nominee to fill the office for which he has been selected and their names with the offices to which they have been nominated shall be published in the October issue of the JOURNAL.

Art. B-IX—Section 2. The Secretary shall prepare ballots with the names of all candidates and forward them to the members, eligible to vote, at least thirty (30) days before the date of the Annual Meeting.

Nominations for Members of Committee on Research

Although committees of the Society are usually appointed, in view of the great importance of the Committee on Research and the financial responsibility it would be called upon to assume, it has been made more representative of the entire membership of the Society by a process of *election.* The election is governed by the By-Laws for the election of officers, with the single exception that Members of the Committee on Research are nominated by the Council instead of by a Nominating Committee.

In accordance with the Regulations for the Government of the Research Laboratory, adopted at the January, 1919, Meeting, and amended January, 1933, the Council announces the nomination of the following members of the Committee for election to succeed those members whose present terms expire January, 1935:

Three-Year Term

G. A. DUNHAM, Chicago, Ill.
W. L. FLEISHER, New York, N. Y.
ELLIOTT HARRINGTON, Schenectady, N. Y.
A. P. KRATZ, Urbana, Ill.
H. C. MURPHY, Louisville, Ky.

The regulations governing the nomination and election of members of the Committee on Research are as follows:

ARTICLE II—ORGANIZATION

Section 1. *Committee on Research*—There shall be a standing committee known as the Committee on Research, consisting of fifteen (15) members each serving for three (3) years and five (5) retiring each year. The outgoing Chairman if serving in that capacity during the last year of his three (3) year term on the Committee shall without election become an additional member of the Committee on Research for one (1) year.

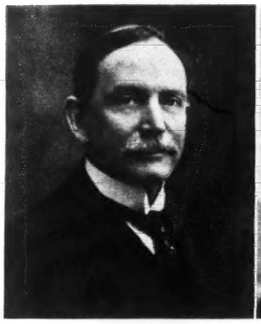
(a) The Council shall nominate previous to July first of each year five (5) members to fill the vacancies of those retiring at the next Annual Meeting.

(*b*) The nominations made by the Council shall be published in the October issue of the Society's Journal.

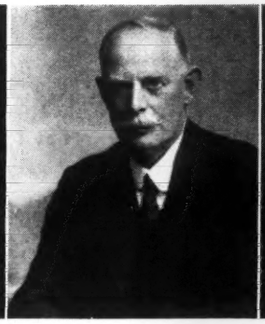
(*c*) Any ten (10) members of the Society eligible to vote may present to the Secretary over their signatures, the name of one (1) or more additional nominees for the Committee on Research, provided such name or names are presented at least sixty (60) days prior to the next Annual Meeting, and such additional nominations shall be placed on the ballot opposite the nominations made by the Council.

(*d*) The election shall otherwise conform to the regulations provided for the election of officers of the Society in the Constitution, By-Laws and Rules.

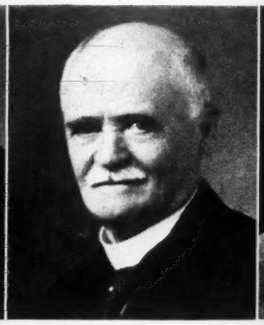
(*e*) Vacancies may be filled by the Council, such persons chosen by the Council to serve until a successor is elected at the next Annual Meeting.



H. S. Downe
President, Cie Nationale des Radiateurs
Paris, France

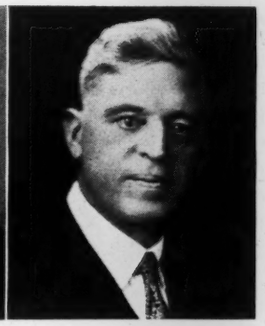


J. N. Russell
Managing Director, Rosser & Russell, Ltd.
London, England



Hugo Theorell
Consulting Engineer, Hugo Theorells, Ingeniorsbyra
Stockholm, Sweden

Kunisuke Sekido
Consulting Engineer
Tokyo, Japan



Walter Leek
President and Managing Director, Leek & Co., Ltd.
Vancouver, B. C., Canada

The Society Goes Around the World

THE A. S. H. V. E. is truly an international organization with members in 20 foreign countries and it is of interest to note that five of these men have held Society membership for more than 30 years.

Henry S. Downe, Paris, France, a Life Member of the Society, holds the record, having been elected in 1895. An English member, J. N. Russell, of London, a past president of the *Institution of Heating and Ventilating Engineers of Great Britain*, was elected in 1899; Hugo Theorell, Stockholm, Sweden, Life Member, joined in 1902; K. Sekido, Tokyo, Japan, Member, and Walter Leek, Vancouver, B. C., Canada, Member, were elected in 1903.

The record shows the interesting fact that the member who has held Society membership longest in Norway is Alf Tjersland, 1916; in China, H. W. Hart-Baker, 1918; in Ireland, P. I. Barry, 1920; in Germany, Dr. Albert Klein, 1920; and in U. S. S. R., M. L. Sakouta, 1924.

It is appropriate that the photos of the oldest Society members in their respective countries be presented with a brief item about each man. When these men were invited to send a word of greeting to their fellow members in the A. S. H. V. E. the response brought forth the following facts:

J. Nelson Russell will visit the United States during October and plans to attend the meeting of the New York Chapter October 15 after which he will go to Chicago to see the Century of Progress.

Hugo Theorell, after graduation from the Royal Technical School at Stockholm, started his own consulting office in 1889 and has worked on some of the country's largest structures.

Kunisuke Sekido, consulting engineer, attended the Tokyo Imperial University and, after several years' service with Takata & Co., he spent a year in their New York office and also made a study of heating practice in England, France, Germany and Holland. In 1929 Mr. Sekido was one of the Society's representatives at the World Engineering Congress.

Walter Leek, president and managing director of Leek & Co., Ltd., is proud of the fact that his company has been established for 126 years. Mr. Leek was born in England, educated in Canada, and, after serving an apprenticeship in his father's business, he was finally placed in full charge of the firm which was established in Harrowgate, Yorkshire, England, in 1808 and has successively come down from father to son.

Alf Tjersland, director of E. Sunde & Co., Ltd., was born in Christiania, Norway, and received his technical education at the Institute of Technology at Mittiveida, Saxony. Mr. Tjersland says, "It seems funny to belong to the old men's membership of the Society as I am still a young fellow of 53 and I hope to come over to the United States in 1936 and also when the Society celebrates its 50th anniversary." "Business in Norway at the present time," he says, "is much better than in many countries because of the large export, shipping, and fishing industries." Mr. Tjersland wants to be remembered to his many friends in the United States and he recalls with pleasure several Society meetings that he attended, particularly that of 1920.

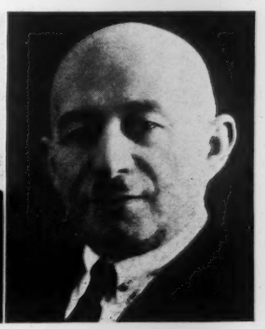
Henry W. Hart-Baker, director, Merritt Limited, was born in England, educated in London and trained as a heating and sanitary engineer. After traveling extensively in the United Kingdom, France, Italy and Switzerland, he went to China in 1915 and his engineering work in the far east has carried him to North China, Manchuria and Korea. Information from the publication, *Men of Shanghai and North China*, shows his affiliation with numerous fraternal organizations and membership in the *Institution of Heating and Ventilating Engineers*, Great Britain, *Institution of Sanitary Engineers*, AMERICAN SOCIETY OF HEAT-

Alf Tjersland
Director, E. Sunde & Co., Ltd., Oslo, Norway

H. W. Hart-Baker
Director, Merritt Limited
Shanghai, China

P. I. Barry
Managing Director, M. Barry Ltd., Cork, Ireland

Dr. Albert Klein
Managing Director, Carrier Lufttechnische Gesellschaft
Stuttgart, Germany



M. L. Sakouta
Consulting Engineer, Leningrad, U. S. S. R.

ING & VENTILATING ENGINEERS, and the *Worshipful Company of Plumbers.*

Patrick I. Barry, the Society's only member in Ireland, was born and educated in Cork, received his training as an apprentice and draftsman with William Robert Costello, and has been sole proprietor of his father's business, M. Barry Ltd., since 1906. He is a member of the *Institution of Heating and Ventilating Engineers* and the *Institution of Sanitary Engineers,* London. He is a member of the Associated Hospitals Committee, which handles the Irish Sweepstakes, and writes, "I have not been lucky enough to draw a winning ticket, an event which would materially hasten my visit to the U. S. A."

Dr. Albert Klein was born and educated in Germany, spent nearly 15 years with construction and manufacturing firms in the United States, and then became managing director of Carrier Lufttechnische Gesellschaft. Dr. Klein is a member of a number of technical societies and says, "I do not know of any that has offered me so many advantages, privileges and pleasure as the A. S. H. V. E. I shall remain a member as long as I shall be active in the heating and ventilating field and probably as long as I live."

Mathieu L. Sakouta, of Leningrad has just completed his tenth anniversary as a member of the Society and as a consulting engineer since 1906, he has been identified with the design and construction of many of the largest buildings in Russia and is proud of the publication of many papers in the technical press that have appeared under his name during the past 30 years. He is the first member of the Society in Russia and finds pleasure in his membership because of the valuable research reports and data which appear in the official publications.

The Girl Who Came Back

Miss Pauline Kurland, a member of the headquarters staff of the A. S. H. V. E. since 1923, has returned from her vacation with a thrilling story to tell of her experiences as a passenger aboard the Morro Castle on its ill-fated Labor Day cruise to Havana. Surviving the fire, the plunge from an upper deck, and several hours immersion in a stormy sea, Miss Kurland was picked up by a Coast Guard boat and landed at Spring Lake, N. J. early on Saturday morning, September 8. Sailing from New York on September 1 with a friend who was rescued, Miss Kurland relates that she is a good sailor and enjoyed every minute until the last night out when disaster overtook the ship. The thrill of her first ocean voyage however outshines the disaster and she is ready to go again.

Miss Pauline Kurland

Following the death of Capt. R. R. Willmott at dinner, the evening's formal party was cancelled and the majority of the passengers retired to their staterooms. Miss Kurland was attending a party on D deck when at 3:00 a. m. she smelled smoke and almost immediately the fire alarm sounded. Rushing to B Deck, she could see flames burning fiercely amidship. When it became apparent that the fire could not be controlled, a friend procured a life belt for her. After some difficulty the lifebelt was correctly adjusted, though the passengers were not familiar with their location, nor had they received instruction or assistance from crew members on the proper procedure to follow in case of emergency. Many passengers who had been overcome were lying on the deck and, although an inexperienced swimmer, when the smoke and heat became unbearable, Miss Kurland pleaded with those obstructing the rail to let her jump overboard.

In the water she clung to a rope near the stern of the ship until the buffeting of the waves caused her to lose her hold, when she started to drift. At some distance other heads occasionally could be seen in spite of the rain and high seas. A big wave washed a young chap, apparently a Cuban, alongside of Miss Kurland and he clung to her lifebelt. Because he was terror stricken and panicky, it was an added handicap. When a large steamer stood by, Miss Kurland tried to make someone see and hear her, but the effort was without result as no rescue boat came near.

After being in the water for almost six hours, Miss Kurland was picked up by a surf boat of the Coast Guard and she then relates that the next 3 hours were the most horrible hours of her life. The crew seemed to have great difficulty getting her into the boat because of the rough seas and the heavily loaded boat. She was badly bruised and when the boat became half-filled with water, the Coast Guard crew expressed their conviction that it would capsize, so that the survivors who were exhausted and ill were terrified. Several oars were lost before they were given a tow and brought to shore at Spring Lake, N. J.

Miss Kurland was given first aid and immediately had a telegram sent to her mother and sister, who were unaware of the Morro Castle's plight until they received her wire. On Sunday afternoon she was driven home, where she has had medical care and rest to enable her to recuperate from shock and exhaustion. She is now back on the job, the heroine of the A. S. H. V. E. staff and considered the luckiest girl alive by her associates.

Modernizing Program Starts Under FHA

For the past two months conferences sponsored by the Federal Housing Administration, directed by James A. Moffett, have been held almost daily in Washington, D. C., to explain the purposes of the National Housing Act passed by Congress last June.

Representatives of financial institutions, manufacturers, contractors, trade and civic organizations have been informed of the advantages to be derived from participation in the FHA plan whereby loans may be obtained for improving commercial, farm, industrial, and residential buildings at low interest rates, from banks, finance companies and building loan associations in amounts from $100 to $2,000 for a term of from one to three years.

Through an organization of ten regional directors and a group of state directors, it is planned to organize community campaigns in order to improve all types of buildings and thereby give employment to men in the construction industry and allied manufacturing fields and provide a market for building materials.

Property owners, financial institutions, and merchants will be organized throughout the country and an illuminating picturization of the possibilities of the Better Housing program will be indicated in a series of sound pictures to be shown throughout the country. Announcements in the daily press, local advertising, and radio broadcasts will be used to explain the modernization plan, with details of the organization set up, the results to be expected and what every individual and property owner can do to assist in making the community programs successful.

At the September 5 conference of trade association executives representing scores of industries, B. J. Flynn, Director of the Industries Division, announced that the Better Housing campaign in local communities was far ahead of schedule and that nearly 500 committees were functioning with the prospect of several thousand community campaigns ready to go ahead within the next thirty days.

At the morning and afternoon sessions in the new Willard Hotel, the subjects discussed were as follows:

MORNING SESSION

How the Better Housing Program Benefits all Industry, Ward M. Canaday, Director, Public Relations.

The Modernization Plan as a Credit Tool, Roger Steffen, Director, Modernization Credit.

Field Organization of the Federal Housing Administration, W. D. Flanders, Director.

M. C. Beman
General Chairman

Committees Appointed for Annual Meeting

Roswell Farnham
Vice-Chairman

The Officers and members of the Western New York Chapter extend a cordial invitation to every Society member to come to the Hotel Statler during the 4th week of January 1935 for the 41st Annual Meeting of the A. S. H. V. E. The General Chairman of the Committee on Arrangements, M. C. Beman, who is a member of the Council and also a past president of the Western New York Chapter, says that his Committee plans a program of entertainment that will provide three enjoyable days for the members and ladies who attend.

The members of the Committee serving with Chairman Beman are Roswell Farnham, vice-chairman; L. A. Harding, Reception; J. J. Landers, Registration; D. J. Mahoney, Entertainment; W. E. Voisinet, Banquet; Cecil Farrar, Publicity; Park Hedley, Transportation; and B. C. Candee, Finance.

Six technical sessions are planned for a discussion of papers covering current topics of interest, such as Tests of Three Heating Systems in an Industrial Type of Building; The Nature of Ions in Air and Their Possible Physiological Effects; Office Building Cooling, and further laboratory studies on Corrosion.

The Newspaper Better Housing Section as a Selling Force, H. D. Newson.

Exhibitions as a Focal Point in Local Campaigns, J. P. Young.

Visomatic Presentation.

AFTERNOON SESSION

The Better Housing Program—A Challenge to Industry, James A. Moffett, Administrator, Federal Housing Administration.

Financial Aspects of the Better Housing Program, Albert L. Deane, Deputy Administrator.

How the Industries Division Federal Housing Administration Can Serve You—B. J. Flynn, Director, Industries Division.

Visomatic Presentation.

President C. V. Haynes and Secretary A. V. Hutchinson, representing the A. S. H. V. E.; J. C. Fitts, Secretary, of the Heating, Piping and Air Conditioning National Contractors and Norman Raber, Secretary of the Plumbing and Heating Industries Bureau were in attendance. The industry advisor for the Heating and Plumbing group is H. C. Williams of New York.

Engineering Courses at Polytechnic

Evening courses in engineering, chemistry and science have been announced by Polytechnic Institute of Brooklyn. A group of graduate courses in engineering, chemistry, mathematics and physics is available to qualified students. Complete details may be obtained from Polytechnic Institute, 99 Livingston St., Brooklyn, N. Y.

Michigan Chapter Announces Season's Program

Tentative plans for the first meetings of the Michigan Chapter have been announced and the call for a meeting combining golf and business on October 10 at the Detroit Golf Club has been issued to members. Following the tournament, the National Housing Act will be discussed, with a representative of the Federal Housing Administration present to explain the plan in detail, and a talking picture to show the various methods available.

In November, the meeting will be devoted to a discussion of Stokers.

A talk on Air Conditioning by Charles Kettering is contemplated during December.

The January meeting will be sponsored by the Detroit Edison Co. and a dance will be held in February.

Heating and ventilating students from the University of Michigan and the University of Detroit will attend the March meeting.

The April meeting will be devoted to Summer Cooling and, in May, the annual meeting will be held, when officers for the coming year will be elected and the usual golf tournament will be enjoyed.

Of Interest to Members

On October 15 Pres. C. V. Haynes will be the featured speaker at the opening meeting of the New York Chapter's 1934-35 season.

First Vice-Pres. John Howatt attended the October 8 meeting of Minnesota Chapter and reviewed the activities of the Society with special emphasis on the research program.

Prof. G. L. Larson, second vice-president of the Society, is back at his desk in Madison after spending six weeks on the West Coast and in the Pacific Northwest.

Treas. D. S. Boyden, (lieutenant colonel in the Massachusetts National Guard) participated in the recent Army maneuvers at Camp Dix, New Jersey.

On October 2, A. V. Hutchinson, secretary of the Society, met with a group of Baltimore members to discuss the possibility of effecting a chapter organization in that city.

Edgar C. Powers has joined the staff of James A. Walsh, Inc., Architects Bldg., Philadelphia, Pa., where a new showroom has been opened for displaying the air conditioning and allied lines distributed by the company.

P. Nicholls, supervising engineer in the Fuel Section, Pittsburgh Experiment Station, U. S. Bureau of Mines, is the author of Bulletin 378, Underfeed Combustion, Effect of Pre-

heat and Distribution of Ash and Fuels, just published by the U. S. Department of Interior. This reports a series of investigations on the burning of solid fuels to determine reactions in fuel beds.

L. P. Breckenridge, a Life Member of the Society, who is professor emeritus of mechanical engineering, Yale University, has written, appreciatively of the work that the Society is doing, from his home, The Brackens, North Ferrisburg, Vt. He says that one of the disadvantages of country life is the lack of opportunity to talk things over with old engineering friends and associates.

J. Nelson Russell, managing director Rosser & Russell, Ltd., London, England,, and past president of the *Institution of Heating & Ventilating Engineers*, arrived in the United States Oct. 1 on the *M. S. Georgic* for a visit with relatives and a trip to the Century of Progress.

Nikolai Alfsen, of Alfsen & Gunderson, Oslo, Norway, arrived in New York on the *S. S. Europa* on September 15 and has planned a six weeks stay in the United States. He is visiting the principal cities of the East and Middle West and will spend at least a week at the Century of Progress in Chicago. While in New York he saw the air conditioning installations of Radio City and the new Metropolitan Life Insurance Co. office building, as well as several industrial plants in the metropolitan district. After visiting the nation's capital at Washington, D. C., he stopped in Pittsburgh to see the A. S. H. V. E. Research Laboratory at the U. S. Bureau of Mines.

Industrial Standardization—Its Principles and Application by John Gaillard, D.T.Sc., M.E. has just been issued and describes the evolution of standardization, the essential functions of standardization in industry, its nominal values and limits and the organization of standardization work. A chapter is devoted to the definition and characteristics of a standard and in the section telling of the development of the practical application of standardization, the work of Frank W. Taylor is detailed and the situation in the United States is summarized. The chapter devoted to standardization in a manufacturing concern describes the establishment of coordinating agencies and the methods of harmonizing the activities of the engineering, manufacturing, inspection departments, etc. This volume of 124 pages, published by H. W. Wilson Co. New York, is bound in blue cloth and is 6¼ x 9½ in. in size.

Annual Reports of Local Chapters

Cincinnati

The annual report of Secy. E. B. Royer of the Cincinnati Chapter gives 27 members on the roll and the following officers and committees in charge of activities:

President—H. N. Kitchell
Vice-President—G. B. Houliston
Secretary-Treasurer—E. B. Royer
Board of Governors—C. J. Kiefer, K. A. Wright, and the officers

COMMITTEES

Meetings
C. E. Hust, *Chairman*
I. B. Helburn
O. W. Motz
J. A. Strobl
K. A. Wright

Membership
H. A. Pillen, *Chairman*
G. B. Houliston
L. G. Powers
Anker Winther
K. A. Wright

Finance
C. J. Kiefer, *Chairman*
R. B. Breneman
E. B. Royer
R. W. Sigmund
H. E. Sproull

Legislation
W. J. Doyle, *Chairman*
J. J. Braun
E. J. Richard

Chapter meetings were held monthly during the 1933-34 season and a synopsis is included in the annual report:

Meeting	*Attendance*	*Speaker*	*Subject*
October 3, 1933	16	W. T. Jones	The Status Quo of the Society.
November 10, 1933	100	F. D. Berkeley	Steam Jet Refrigeration.
December 16, 1933	15	Members	Society and Chapter Business.
January 27, 1934	13	Members	Annual Meeting.
February 13, 1934	34	R. H. Heilman	Heat Conservation from an Engineering Standpoint.
		W. L. Steffens	Practical Examples of the Use of Insulating Materials.
March 27, 1934	119	C. J. Kiefer	Distillery Engineering.
April 10, 1934	17	J. R. McConnell	Air Cleaning as Applied to Modern Air Conditioning.
May 8, 1934	15	C. V. Haynes	Your Society, What It Means to You.
		John Howatt	Research.

Cleveland

On July 18, 1934 the Cleveland Chapter called a special meeting to which the *Cleveland Association of Consulting Engineers* was invited to discuss the proposed amendments of the Board of Building Standards to the Ohio State Building Code. The consensus of opinion of this meeting was expressed in a resolution to the Board of Building Standards opposing passage of the proposed amendment.

At the July meeting the following officers were elected:

President—M. F. Rather
Vice-President—H. B. Matzen.
Secretary—E. J. Vermere.
Treasurer—H. M. Nobis.
Board of Governors—G. L. Tuve. C. F. Eveleth, F. A. Kitchen.

A synopsis of meetings held during the past season is included in the annual report of Secy. E. J. Vermere:

October—W. H. Driscoll, New York, N. Y., past president of the A. S. H. V. E. and chairman of the Committee on Ventilation Standards, selected as his subject The Romance of Building and detailed the engineering problems encountered during the construction of the Waldorf Astoria Hotel. Attendance—20.

November—F. C. Houghten, Pittsburgh, Pa., director of the Society's Research Laboratory, spoke on Application of Cooling to Buildings in Summer. He illustrated the effect of various types of shades, blinds and awnings on room temperature and on the cooling load. Mr. Houghten also pointed out the practical benefits to engineering practice resulting from research work carried on by the laboratory and answered many questions which had been prepared by members. Attendance—21.

December—J. H. Walker, Detroit, Mich., a member of the Committee on Research, discussed Experiences with Summer Cooling in Detroit and with the aid of slides described the results of experiments conducted during the summers of 1932 and 1933 in an 8-room residence. Attendance—21.

January—This meeting, which was held at the Case School of Applied Science, was one of the most interesting of the season and was preceded by an inspection of the engineering laboratory. The first speaker, Prof. G. L. Tuve, gave a resumé of the research and experimental work in heating, ventilating and air conditioning at Case School. Prof. J. R. Martin spoke on the subject of Measurement and Elimination of Noise in Ventilating Equipment. Attendance—52.

February—John Howatt, Chicago, Ill., 1st vice-president of

the Society and chairman of the Committee on Research, discussed the Selection and Maintenance of Mechanical Equipment for School Buildings. Attendance—25.

April—This meeting was held at the laboratory of the *American Gas Association* and R. M. Conner spoke on Activities of the *A. G. A.* Following his talk, an inspection of the building was made. Attendance—19.

May—Three speakers discussed several systems used in cooling apparatus and their application. L. T. Avery reviewed briefly the fundamentals of air conditioning and the various methods of mechanical refrigeration in his talk on Mechanical Refrigeration applied to Air Conditioning. W. E. Stark spoke on Air Conditioning with Solid Adsorbents, detailing the apparatus used and the results obtained with silica gel and activated aluminum. F. R. Dickenson discussed Steam Jet Refrigeration for Air Conditioning and explained the method of producing a high vacuum by means of a high velocity steam jet and the apparatus required. Attendance—38.

During the year 12 new members were received and the roll of membership of the Chapter included 3 honorary members and 52 active members.

Illinois

A summary of the meetings of the Illinois Chapter held during the past season has been prepared by Secy. J. J. Hayes as follows:

Meeting	*Attendance*	*Speakers*	*Subjects*
October, 1933	46	S. R. Lewis	Code of Fair Competition for the Professional Engineer.
November, 1933	79	A. C. Willard	Theory and Practice in Heating and Ventilating Work.
December, 1933	89	H. E. Bates	Supplying Gas to the City of Chicago.
January, 1934	137	O. T. Kreusser	Purpose and Aims of the Museum of Science and Industry.

Ladies were invited to the January meeting and dinner was served at the Hotel Windermere-East at 7:30 p. m. It was preceded by an inspection visit to the Museum of Science and Industry founded by Julius Rosenwald.

February, 1934	261	W. W. Reece	Air Conditioning in Bakeries.

The February meeting was held jointly with the Chicago Section of the *A. S. R. E.*

March, 1934	119	J. F. Hale	Vapor Heating.
		H. M. Hart	Gravity Hot Water.
		E. V. Hill	Fan Furnace.
		S. R. Lewis	A Modern Heating System.

The March meeting was known as Presidents' Night, with C. V. Haynes, president of the A. S. H. V. E., as guest of honor. Mr. Haynes spoke on Your Society—What Does It Mean to You?

April, 1934	62	P. L. Davidson	Air Conditioning the Philadelphia Savings Fund Society Building.
May, 1934	51	James Aston	Corrosion in Heating, Ventilating and Air Conditioning Apparatus.

On May 25, 1934, a special meeting, to which the ladies were invited, was held at the Germania Club. Dinner was served to 35 members and guests, after which a special visit of inspection was made to the Chicago Historical Society Building.

The Illinois Chapter enjoyed a fine attendance at the eight regular meetings with an average of 105.

The Annual Meeting of the Society at New York was attended by 14 members of the Chapter, while 8 enjoyed the Summer Meeting at Buck Hill Falls.

The Annual Meeting of the Illinois Chapter and the election of officers are held on the second Monday of October. The officers and committees who served the Chapter during 1933-1934 are:

President—C. W. DeLand.
Vice-President—R. E. Hattis.
Secretary—J. J. Hayes.
Treasurer—J. H. Milliken.
Board of Governors—G. H. Blanding, J. J. Haines, S. I. Rottmayer, J. H. O'Brien.

COMMITTEES

Membership
R. E. Hattis, *Chairman*
J. F. Hale
J. J. Haines
S. L. Haas
H. G. Kreissl

Legislative
E. V. Hill, *Chairman*
E. P. Heckel
A. B. Martin

Better Relations
J. J. Aeberly, *Chairman*
S. R. Lewis
L. L. Narowetz, Jr.

Meetings and Publication
S. I. Rottmayer, *Chairman*
John Howatt
S. M. Trumbo
C. E. Crone, Jr.
H. B. Johns

Finance
J. H. Milliken, *Chairman*
H. G. Thomas
Russell Doherty
J. D. Small
B. L. Casey

The Illinois Chapter lists 133 members on its rolls.

The officers and members look forward to the coming season, 1934-35, with hope and confidence for the success of the Illinois Chapter.

Michigan

The Michigan Chapter plans to open the season's activities with a golf tournament to be held in October and the officers and committee members to date are:

President—G. D. Winans
Vice-President—A. C. Wallich
Secretary—W. F. Arnoldy
Treasurer—R. K. Milward
Board of Governors—Edward Glanz, J. S. Kilner, H. E. Paetz, F. J. Feely
Speaker and Educational Committee—W. G. Boales, *chairman;* F. J. Feely, *vice-chairman*
Reception Committee—H. E. Paetz, *chairman;* E. E. Dubry, *vice-chairman;* L. L. McConachie
Membership Committee—A. P. Darlington, *chairman*

Monthly meetings were held during the year and the subjects of discussion were as follows:

October 4, 1933. Golf outing and dinner at the Detroit Golf Club. C. V. Haynes, Philadelphia, Pa., 1st vice-president of the Society, gave an instructive talk to the Chapter on A. S. H. V. E. activities and C. W. Farrar, Buffalo, N. Y., was toast master. Among those presented were J. R. McColl, J. F. McIntire, R. L. Spitzley, J. H. Walker, L. L. Smith, Tom Brown, N. J. Hill, W. A. Rowe, and E. E. Dubry. Attendance—80.

November 13, 1933. Wardell Hotel. Speakers: Milton Powers, who explained the engineering details of a boiler burner unit; D. J. Luty, who gave a detailed description of the design of boiler burner units and discussed the oil burning warm air furnace; York Giddey, who read a very complete description of a boiler burner unit; and E. S. Jeffries, who gave some interesting points relative to early experiences of conversion burner sales. Attendance—102.

December 11, 1933. Wardell Hotel. Speaker: S. R. Lewis, Chicago, Ill., who gave a paper on Air Conditioning. Attendance—65.

January 22, 1934. Detroit Edison Co. Bldg. Speaker: H. A. Snow, who addressed the meeting on the subject of Public Utility Dollars. Attendance—80.

February 12, 1934. Dinner dance at the Wardell Hotel, which was enjoyed by 100 members and guests.

March 19, 1934. Wardell Hotel. Speakers: C. V. Haynes, Philadelphia, Pa., president of the A. S. H. V. E., spoke on the operation of the Society; Arthur Herske talked on the condition of the construction industry and what the future held; Malcomb Bingay, of the Detroit Free Press, gave an inspiring message on Our Detroit. Attendance—95.

April 16, 1934. Hotel Wardell. Speakers: C. L. Toonder, who discussed a humidity chart; E. E. McWan, who stressed the importance of well trained salesmen in the air conditioning field;

and E. L. Hogan, who discussed some of the technical points of the industry. Attendance—150.

May 16, 1934. Following an afternoon of golf and baseball at the Meadowbrook Golf Club, the annual meeting and election of officers was held. Attendance—60.

Minnesota

Plans for the 1934-35 season of the Minnesota Chapter are well formulated and the annual report of Secy. R. E. Backstrom outlines the following programs:

September 17, 1934—At Hamm's Brewery, St. Paul, Minn. An inspection trip through the newly completed power plant and a talk by Albert Buenger.

October 8, 1934—At Men's Union, University of Minnesota, Minneapolis. Address by John Howatt, first vice-president, A. S. H. V. E.

November, 1934—Annual Party.

December 10, 1934—At Men's Union, University of Minnesota, Minneapolis, Minn. Technical paper to be presented by a chapter member.

The officers of the Chapter and personnel of the committees are:

President—C. E. Lewis.
Vice-President—C. E. Gausman.
Secretary-Treasurer—R. E. Backstrom.
Board of Governors—A. B. Algren, F. C. Winterer.

COMMITTEES

Meetings
C. E. Gausman, *Chairman*
F. B. Rowley
Albert Buenger

Legislative
E. F. Jones, *Chairman*
R. W. Otto
J. B. Harris

Publicity
R. C. Jordan, *Chairman*
J. E. Swenson
G. C. Morgan

Auditing
D. C. Ruff, *Chairman*
G. A. Dahlstrom
E. F. Bell

Nominating
H. E. Gerrish, *Chairman*
D. M. Forfar
W. F. Uhl

Entertainment
F. H. Schernbeck, *Chairman*
J. R. Hall
D. M. Forfar
N. D. Adams

Membership
A. J. Huch, *Chairman*
A. B. Algren
F. C. Winterer
C. E. Lewis
L. C. Gross
Albert Buenger

Attendance
Minneapolis—R. C. Jordan
St. Paul—William McNamara

A synopsis of meetings held during the past year gives the subjects, speakers, and attendance of members and guests:

September 24, 1933—Prof. F. B. Rowley discussed the NRA code for engineers. Attendance—24.

October 23, 1933—Pres. W. T. Jones talked on the Status Quo of the Society. Attendance—48.

November 7, 1933—F. D. Berkeley discussed The History and Application of the Decalorator. Attendance—90.

December, 1933—Annual party held at the Thorpe Country Club, Minneapolis, Minn. Attendance—50.

January 8, 1934—M. I. Dorfan presented Technical Discussion on Dust and Dust Collection. Attendance—50.

February 7, 1934—J. E. Swenson gave a paper on The Use of Gas Fuel for Home Heating. Attendance—80.

March 12, 1934—Two papers on the most economical way to air condition houses were presented by local Chapter members. Attendance—40.

April 9, 1934—Prof. F. B. Rowley presented a paper on Heat Transfer of Bright Metallic Surfaces. Attendance—40.

May 14, 1934—Annual golf tournament and election of officers held at Thorpe Country Club, Minneapolis, Minn.

At the present time 76 members are on the Chapter membership roll.

New York

The activities of the New York Chapter have been outlined in the annual report of Secy. T. W. Reynolds, which gives a membership of 184 and an average attendance at meetings during the year of 85.

The present officers are:
President—H. W. Fiedler.
Vice-President—W. W. Timmis.
Secretary—T. W. Reynolds
Treasurer—W. M. Heebner.
Board of Governors—A. F. Hinrichsen, H. L. Alt, S. A. S. Patorno.

A synopsis of meetings held during the past chapter season follows:

October 16, 1933—Dr. C.-E. A. Winslow, director, School of Public Health, Yale University, addressed the Chapter on some of the newer physiological considerations of fresh air. Dr. Winslow also reviewed the history of ventilation from its earliest inception up to the latest developments in radiant heating in England where different instruments and terminology are used. He pointed out certain advantages of such a method for intermittent heating and for warming only certain parts of a room. The speaker expressed the opinion that in the future thermal interchange might no longer be considered alone as vital, where such things as wave length effects, negative ions, nose effects of heat, etc., were being discussed. He issued a warning that decisions be postponed until solid evidence arrives of the worth of the many theories now being proclaimed.

J. G. Eadie, consulting engineer, was the next speaker and discussed Highlights of the Engineers Code. An outline was given of all that had been done to make the code workable and a fair foundation upon which to build a more lasting structure. Attendance—74.

November 20, 1933—C. F. Neergaard, a prominent hospital consultant, spoke on The Significance of Engineering Economy in Hospital Design. Mr. Neergaard gave a very interesting talk and stressed the need for greater care in the planning period, having in mind the actual operation of the equipment. Mr. Neergaard closed his remarks with the suggestion that engineers take a more positive and aggressive attitude when building plans are being prepared.

W. T. Jones, president of the A. S. H. V. E., spoke on The Status Quo of the Society and gave some statistics regarding research, membership, and finances, which were very interesting and unknown to many of those present. Attendance—104.

December 18, 1933—The Operating Principles, History and Design of Steam Vacuum Refrigeration was ably discussed by F. D. Berkeley and illustrated by slides and charts. Attendance—71.

January 15, 1934—Capt. C. M. Simmers, production officer of the U. S. Navy Yard, spoke on Heating and Ventilation of Naval Vessels. Captain Simmers threw new light on how heating and ventilating problems are met in this specialized field. The slides and exhibits of aluminum foil used for insulating naval vessels were of considerable interest. Attendance—86.

February 19, 1934—The Heat Pump and the Measure of its Economy was the subject of W. L. Fleisher. Reverse cycle refrigeration is of great interest in the air conditioning field and Mr. Fleisher discussed this stimulating subject in his usual interesting way. Attendance—55.

March 19, 1934—Dr. D. B. Steinman, consulting engineer and past president of the *New York State Society of Professional Engineers*, gave an interesting talk on the licensing of professional engineers in the State. Dr. Steinman remarked that the first New York law was enacted in 1920 and at the time of the meeting there were 10,000 licensed professional engineers in the state.

A. G. Corbin, deputy superintendent of schools, Yonkers, N. Y., presented some interesting detailed data on the costs of schoolhouse construction. Attendance—50.

April 16, 1934—A discussion of Various Types of Heating Plants and Controls for Economy and Comfort, with Central Station Steam Service by W. J. Baldwin, Jr., and A. R. Mumford, aroused considerable interest as various types of controls have come into quite general use, especially in New York City with central station service. Attendance—50.

May 21, 1934—The season's activities were closed with the customary annual dinner and entertainment held at the Villa Venice with an attendance of 184. Al Engle arranged the program and H. T. Richardson was master of ceremonies.

CANDIDATES FOR MEMBERSHIP

The Constitution of the Society as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 49 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn the Council, urge the members to assume their share of the responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by October 15, 1934, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

CANDIDATES	*REFERENCES*	
	Proposers	*Seconders*
ALLMEN, N. S., Student, Case School of Applied Science, Cleveland, Ohio.	G. L. Tuve W. E. Stark	F. H. Vose (*A. S. M. E.*)
BEARD, EARL L., Student, University of Oklahoma, Norman, Okla.	E. F. Dawson J. H. Felgar (*Non-Member*)	W. H. Carson (*Non-Member*) H. V. Beck (*Non-Member*)
BOWMAN, JAMES W., Student, University of Oklahoma, Norman, Okla.	E. F. Dawson J. H. Felgar (*Non-Member*)	W. H. Carson (*Non-Member*) H. V. Beck (*Non-Member*)
BROOKS, FRANK W., Student, Case School of Applied Science, Cleveland, Ohio.	G. L. Tuve W. E. Stark	F. H. Vose (*A. S. M. E.*)
BURKE, WILLIAM J., Texas Distributor, Betz Unit Air Cooler Co., Tulsa, Okla.	H. D. Betz E. K. Campbell	E. K. Campbell, Jr. L. A. Stephenson
CARTER, Doctor, Htg. & Sanitary Engr., Shanghai, China.	H. W. Hart-Baker C. J. Merritt	J. P. Cosgrove (*Non-Member*) W. R. Zuhlke
CHESNUTT, NELSON P., Student, University of Oklahoma, Norman, Okla.	E. F. Dawson J. H. Felgar (*Non-Member*)	W. H. Carson (*Non-Member*) H. V. Beck (*Non-Member*)
COOK, ALTON B., Student, University of Oklahoma, Norman, Okla.	E. F. Dawson J. H. Felgar (*Non-Member*)	W. H. Carson (*Non-Member*) H. V. Beck (*Non-Member*)
DAVIS, JAMES R., Student, Case School of Applied Science, Cleveland, Ohio.	G. L. Tuve W. E. Stark	F. H. Vose (*A. S. M. E.*)
DAWSON, EUGENE F., Asst. Prof., Mech. Engrg., University of Oklahoma, Norman, Okla.	F. B. Rowley A. I. Brown	W. H. Carson (*Non-Member*) J. H. Felgar (*Non-Member*)
DOSTER, ALEXIS, Secy. & Director, The Torrington Mfg. Co., Torrington, Conn.	W. G. Boales J. F. McIntire	E. N. McDonnell S. H. Downs
DUGGER, EARL R., Student, University of Oklahoma, Norman, Okla.	E. F. Dawson J. H. Felgar (*Non-Member*)	W. H. Carson (*Non-Member*) H. V. Beck (*Non-Member*)
EMMONS NEAL L., Student, University of Oklahoma, Norman, Okla.	E. F. Dawson J. H. Felgar (*Non-Member*)	W. H. Carson (*Non-Member*) H. V. Beck (*Non-Member*)
EVEREST, R. H., Sales Engr., Sheldons, Ltd., Galt, Ont., Canada.	G. A. Playfair W. P. Boddington	W. C. Oke J. S. Wood
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